THE

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THE WORKING OF THE EIGHT HOURS ACT IN MINES.

IN a recent article dealing with the railway strike, we referred incidentally to the serious consequences resulting from State interference with, or regulation of, particular industries, and if any proof were needed we have only to turn to the reports of H.M. Inspectors of Mines for the year 1910, which have recently been issued, to see the effect of the working of the Eight Hours Act; an Act, by the way, which was forced on the industry at the instigation of the men's leaders, in face of the determined opposition of the coal owners, and many of the workmen themselves, and all the allied industries which depend more or less for an existence upon a cheap and sufficient coal supply.

The total production of coal for last year was 264,433,028 tons, being an increase of 658,716 tons over the previous year. The increase, however, was not common to the whole eight inspection districts, four showing increases, viz., Yorkshire and North Midland 2,896,148 tons; Scotland, 1,556,767 tons; Midland and Southern, 839,429 tons; and Liverpool and North Wales, 83,307 tons; while four showed decreases, viz., Durham, 1,690,020 tons; South Wales, 1,663,955 tons; Newcastle, 1,145,996 tons; Manchester and Ireland, 226,964 tons. The increase in the Yorkshire district was in all probability due to the development of the new East Yorkshire coalfield, whilst the decrease in Durham, Newcastle, and South Wales districts was to some extent caused by strikes, which in the case of the two former were due solely to the introduction of the Act.

At first sight it would appear that if there is an increased production, no great harm can have resulted from the reduction of the hours of labour, but when we note that there is an increase in the number of persons employed to the extent of 35,409, and of these no fewer than 30,000 are employed below ground, and, further, that in point of production the output is 12 tons *less* per person employed than it was in 1909, we begin to appreciate the importance of its actual effect. The following table which shows the average output of mineral (including fireclay, shales, &c.) per person employed below ground is interesting :—

	Output per person employed. 1910. Tons.	1909. Tons.	Increase or decrease.
Scotland	412	407	+ 5
Newcastle	301	335	— 34
Durham	366	408	— 42
Yorkshire and North Midland	349	344	+ 5
Manchester and Ireland ...	284	297	— 13
Liverpool and North Wales ...	291	291	—
South Wales	270	289	— 19
Midland and Southern	336	333	+ 3
Average	328	340	— 12

With regard to Scotland, it is important to note that the increased production is due to a considerable extent to the introduction of coal-cutting machines, the increase in the

number of these being no less than 82, and the increased production of machine-mined coal over the year 1909 being 1,403,491 tons. The increase in the number of persons employed below ground is 3,130. Of the total number of coal-cutting machines (581), 425 were driven by electricity and 156 by compressed air.

The Inspector in his report for the Newcastle district says: "There are 7,119 more persons employed in 1910 than in the preceding year, principally due to the *increased number of transit hands* rendered necessary by the Eight-Hours Act." (The italics are ours.) "As might have been anticipated, owing to stoppages consequent upon the Eight-Hours Act coming into operation, the output per person has fallen considerably." Again, in the Durham district, the Inspector reports: "The large decrease in the quantity of mineral raised per person employed is due to the reduction in the total output caused by several large collieries not being at work during the first three months." As is well known, these stoppages were purely due to the Act.

Mr. Pickering, however, deals very thoroughly with the economic aspect of the working of the Act in his district, viz., Yorkshire and North Midland, the direct effect of which he says has been "to increase the number of persons for a given output; to reduce the average weekly earnings, and to increase the cost per ton." In many "favoured" mines the increased cost is very small, but in others both the increase in cost per ton and the reduction in weekly earnings is "very serious." It is also worth noticing that it is the person who is willing to work who is hit the hardest, as Mr. Pickering says, "The reduction in wages is most severely felt by those men who were accustomed to work overtime"; and Mr. Nicholson (Durham district) practically says the same thing, as "The Act has made an appreciable difference in the weekly wages of stonemen, deputies and other off-hand persons; these classes of labour prior to the commencement of the Act having had a varying amount of overtime."

Mr. Pickering, however, gives actual facts and figures which are so interesting that they will bear quoting in full. He says: "At a large group of mines having an aggregate output of *15,000 tons per day* (the italics are ours), the Act caused the following changes:—(*a*) The number of coal-getters was increased by 9·5 per cent.; (*b*) the working costs were increased by 3d. per ton; (*c*) the number of tons obtained per man decreased 7 per cent.; (*d*) the stallman's wages decreased by 6d. per day; and (*e*) the output increased by 2 per cent. At one large mine the following changes were made to meet the new conditions. New boilers increasing the steam pressure from 50 lb. to 100 lb. were provided, the winding engines were fitted with larger cylinders, cages of four decks were substituted for those of two decks, more pit room was provided, and the number of underground workers increased by 11 per cent. The result was that, though the output was increased by 16 per cent., the working cost per ton *increased* by 2·5 per cent. . . . The changes at two large mines are given in the following table:—

Reduction in output per man per shift	10 per cent.	7 per cent.
Stallmen's wages reduced per shift ...	2s.	2s. 8d.
Increased wages costs	1·5d.	0·02d.

And as the tonnage got at each mine is about the same for each year, the large decrease in the wages of the stallmen is due to there now being four stallmen in each working place, compared with three in 1908. The wages of the miners have been more equally distributed." At six other collieries each having a large output, the working costs have increased and wages have been reduced according to the following table:—

Working cost increased per ton	1d.	1d.	3d.	½d.	3d.	4d.
Stallmen's wages reduced per shift	11d.	11d.	9d.	11d.	2d.	11d.

The figures clearly show, as Mr. Pickering says, that it is not possible to get the same amount of work done in eight hours as in a longer period, and prove, if proof were ever needed, that however much truth there may be in the statement that the workman "loafs" in other industries, the miner was doing his "level best." It is especially interesting to note the efforts of the owners to maintain, if not actually to increase, the outputs of their respective collieries, and it is undoubtedly due to this that the general public have not been called upon to pay a greatly enhanced price for this staple product. Mr. Pickering also reports an increase of 71 coal-cutting machines, which resulted in an increased production of 542,889 tons of machine-cut coal.

Mr. Johnstone, for the Midland and Southern district, reports similarly, inasmuch as coalowners state that the effect of the Act has been to reduce considerably the output of mineral and increase the cost of production; "but as the output has been sufficient to meet the requirements of consumers, there has been no corresponding advance in selling prices."

With regard to accidents, it is also important to note that last year the total number of deaths was the highest recorded in any one year, and further that the number of deaths from "falls of ground" is also the highest on record, and whilst we admit it was a most disastrous year for explosions, there is some reason to think that the number of accidents due to "falls of ground," &c., would not have been so many were it not for the undoubted "speeding up" of the workmen in their honest endeavour to maintain their wages.

The application of the Act, however, is not without its lessons, the chief of which is that it clearly shows that no industry can be much, if at all, improved by State regulation; that the hours of labour and rate of wages can never, so long as the law of supply and demand remains, be regulated by Act of Parliament; and that it is hopeless to attempt to fix a standard rate of wages, together with the exact number of hours which one is to work to earn them. We trust, however, that at least the Act will teach the miner that no one can look after his interests so well as *himself*.

Olympia Electrical Exhibition.

It is impossible for those who are not behind the scenes, or who have no experience in such matters, to understand what an enormous amount of work is entailed in the organising of an exhibition such as is to be opened at Olympia during the present month. That work becomes harder when those who could lighten it put off their action until the last minute. We are in a position to know that very real efforts have been made to secure a fine demonstration of electric cooking and heating apparatus, and it will be in the memory of our readers that the committee went so far as to offer free space and free supply of energy to firms who would, by a suitable exhibition and demonstration, help to make this feature a most impressive one. A number of firms have thrown themselves into the matter with zest, and a good showing is assured; but there are others who ought to have made up their minds to be there, but have not as yet done so. To such we would suggest that immediate action on their part will greatly assist. There is no time to lose. Three weeks to-morrow the exhibition opening ceremony will take place. We believe, also, that there is room for a little more enthusiasm on the part of those who propose to purchase tickets for distribution among prospective consumers of electricity and apparatus, whose attendance they are anxious to secure. The earlier the tickets are in circulation, the more the public will talk about the coming event, and that is one of the chief things required in order to secure a full popularity for this exhibition by the time of its opening. We suggest that electricity supply engineers and their committees buy their tickets and distribute them at once.

THE SWISS TOUR OF THE INSTITUTION OF MECHANICAL ENGINEERS.—IV.

By our special commissioner.

In our last article we saw over what a very large area, extending 70 miles from east to west, electrical energy is distributed from Beznau, and how, for several years past, the demands made upon this station became excessive and beyond the capacity of its natural resources. On the other hand, the water of the Löntsch river has been utilised in the mills at Netsal, near Glarus, for several generations back; but only to a small percentage of the total annual rainfall over its gathering ground, which has an area of nearly 32,000 sq. miles, or 82,000 sq. km. A large part of this is high and rugged mountain land with many extensive glaciers, on which the snowfall is heavy. This melts in the springtime, and comes down in torrents, lasting between two and three months. It was stored in some small degree in the natural lake Klönthalersee, but most of it ran waste. Ever since 1896 various schemes have been proposed for utilising this great bulk of water. A remarkable and instructive historical fact is that each new scheme was more ambitious than its predecessor, and that effective financial support was not obtained until the project was designed for the total storage and electrical development of the whole annual available water-power. This was undertaken in 1904 by the "Motor" Aktiengesellschaft, of Baden, who are the proprietors of the Beznau Works. The two stations, 85 km. apart, are now connected and mutually support each other throughout the year, the Löntsch Works adding a steady supply of from 36,000 to 40,000 e.h.p. to the combination. This linking up is the more profitable, because the Klönthalersee lies at the extreme south-east end of the district supplied from Beznau, while Beznau is only 32 km. from its extreme western end.

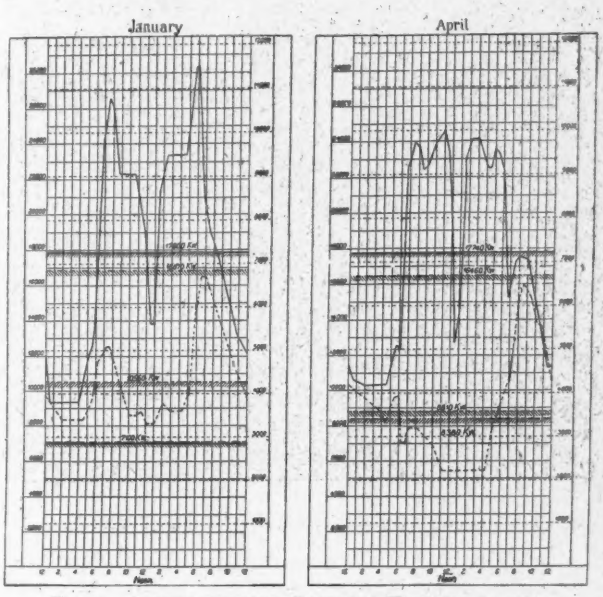


Fig. 1.—Curves showing Combined Working of the Löntsch and Beznau Stations.

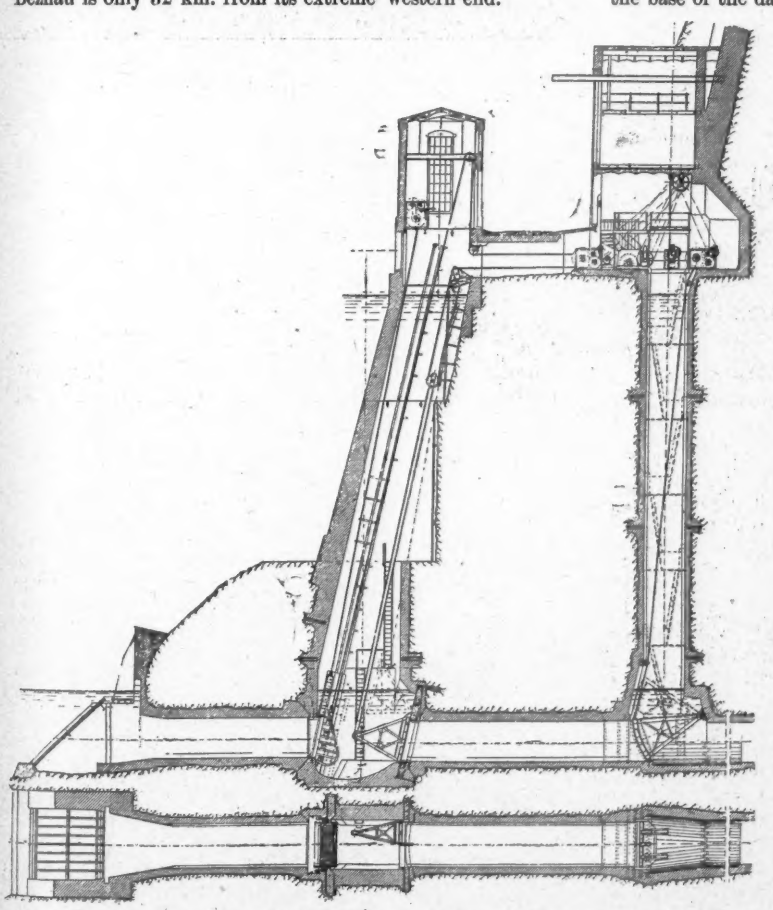


Fig. 2.—Shafts and Sluice Gates at Entrance to Supply Tunnel.

The Klönthalersee was formed in a narrow valley by very ancient "mountain-slides" which broke down parts of the Wiggis and Glärnisch ranges and blocked up the valley. The natural barrier so formed has now been improved by the building of a dam 21 m. high above the natural surface. Its rammed clay-puddle core goes 6 m. further down in an excavated trench, and is 10 m. thick at ground level and 230 m. long across the valley. It was necessary to run this a considerable distance up the south shore of the lake to ensure absolute water-tightness and safety. The width of the base of the dam within outside surfaces varies from 80 to 120 m., the normal being 103 m. This dam contains no less than 110,000 cb. m. of built-in material, of which 25,000 cb. m. are in the watertight core.

The overflow from the lake is in the form of a round vertical tower of 7 m. internal diameter, and whose outer top edge has a diameter of 10 m., and therefore an overflow circular periphery of 31·4 m. This edge stands at 850 m. above sea level, while the lowest water level is 820 m.; so that a 30 m. variation of depth is available, and this corresponds to a storage of 50 million cb. m. of water. When full the water surface has an area of 3·2 sq. km.; so that a variation of 1 m. depth at top level means over 3 million cb. m. storage. This is probably the largest artificial storage reservoir yet constructed in Europe.

Although the power house is designed to use practically the whole of the water supply throughout the year, it is, of course, essentially impossible to keep the lake level constant, and there follows also the physical impossibility of keeping the working head at the turbines quite constant; and again, there results from this an unavoidable variation in the quantity of water flowing per second.

In possible torrential seasons the lake level will rise about ½ m. above the edge of the overflow tower, the section of this tower and of the tunnel leading from its base being sufficient to carry off the flow due to this head. When the Institution party visited the place, there was an overflow with a head of 5 or 6 in. over the edge, and this produced a singularly beautiful conical cascade down the interior of the tower, the waters meeting in the centre at a depth of some 10 or 12 m. below the top.

D

Fig. 1 gives some curves for the months January and April, showing the effect of working the Löntsch and Beznau power houses together, each diagram being for one day of 24 hours. The upper full line is the load curve at Beznau plotted to the right-hand vertical scale; in April this rises to about 10,000 KW., and in January to about 11,500. The similar dotted line is the load curve for a holiday. Owing to want of water storage at Beznau, these works by themselves have been able to utilise only about half the energy available in their water supply. Combined with Löntsch this percentage is raised to about 90 per cent. The left-hand scale in fig. 1 is reduced from the right-hand scale, so that when, from the sum of the mean load at Beznau and the mean power required at Löntsch independently of Beznau there is substracted the mean water-power available at Beznau, there remains a load equal to the mean available water-power at Löntsch The 24-hour mean consumption at Beznau is now 17,900 KW. on a working day in January and 10,550 KW. on a holiday. Of this the Beznau turbines supply 7,100 KW. The mean consumption taken over a week, calculated for six working days and one holiday, is 16,870 KW. in January. The difference, 16,870 − 7,100 = 9,770 KW., is supplied from Löntsch as a

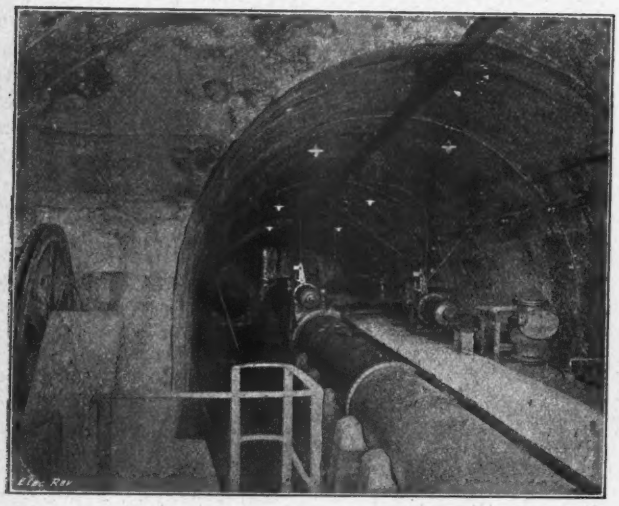


FIG. 3.—JUNCTION OF ROCK TUNNEL AND STEEL FLUME TUBES.

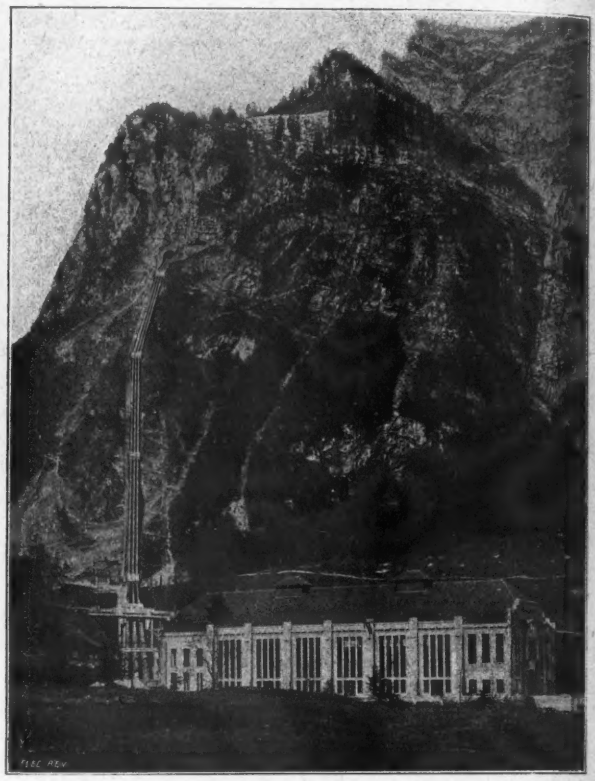
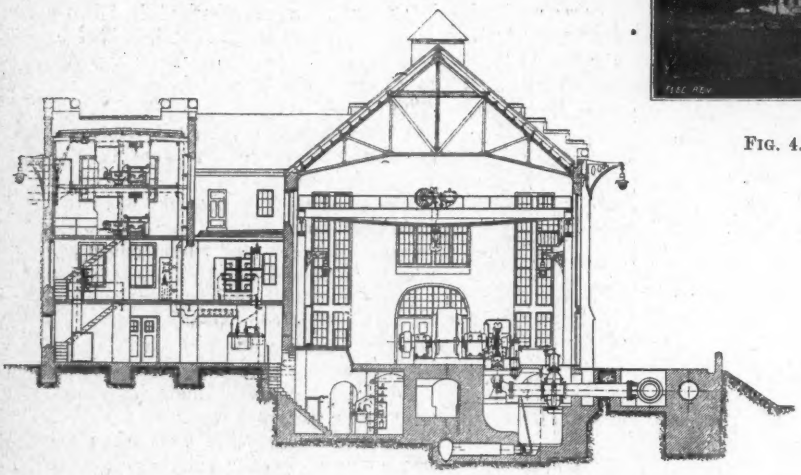


FIG. 4.—LÖNTSCH POWER HOUSE AND FLUME.



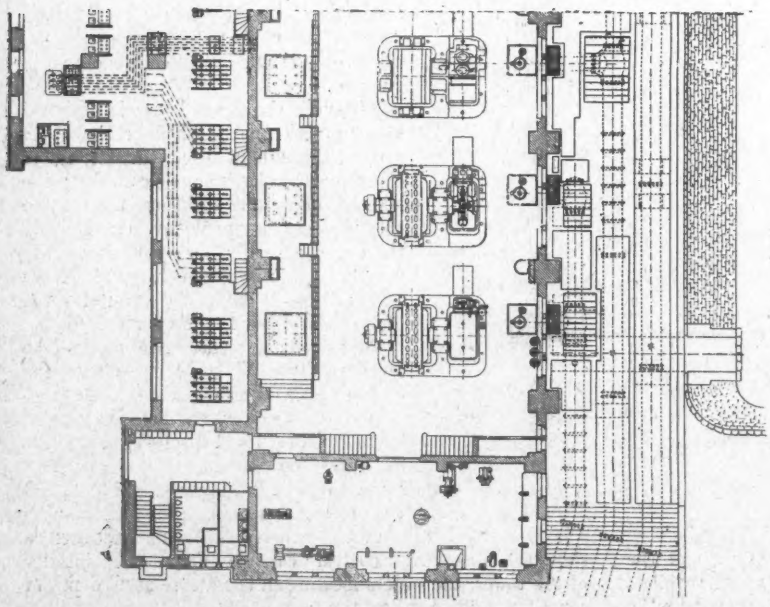


FIG. 5.—HALF PLAN AND SECTIONAL ELEVATION OF THE LÖNTSCH POWER HOUSE, 36,000—40,000 H.P.

mean. But to the left-hand scale the load curve goes up to 28,100, and the excess of this over 7,100, namely, 21,000 KW., is the maximum supply from Löntsch to Beznau. This was the fundamental calculation on which the quantities for the Löntsch construction were estimated. The supposition was that the load curve would retain the same form when the supply was nearly doubled—a supposition which is evidently not quite accurate, but the error of

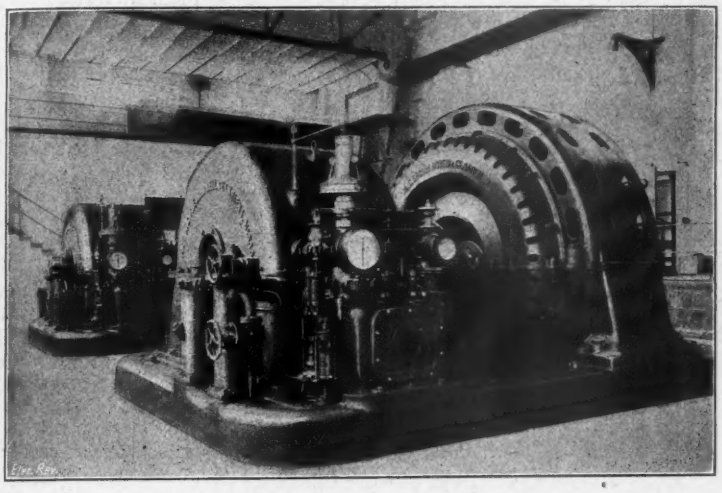


Fig. 6.—Pelton Wheels and Generators, Löntsch Station.

which could not be calculated beforehand and obviously lay upon the safe side.

The constructive work at the reservoir, and between it and the power house, is of very great and special interest, and of particularly high quality both in design and in execution; but it is not the class of work in which our readers are personally interested, and we will, therefore, not describe it in detail, but will only mention its leading features and dimensions.

To make certain of the strength and stability of the dam, the level of the lake was raised in a series of 5 or 6 m. steps at considerable time intervals. This necessitated ample means of drawing off excess water independent of the overflow over the top of the tower, and such means were also permanently desirable in case of future need of cleaning or repairing the face of the dam. The overflow tower was, therefore, combined with a low-level waste tunnel through the base of the dam; and a low-level entrance to this tunnel from the lake was built, consisting of two flumes, each closed by a heavy centrally-hinged circular valve of 1·4 m. diameter.

The supply to the power house is taken from a point on the north shore of the lake, at a distance of 0·7 km. from the dam. The level of the centre of the tunnel is 25 m. below the overflow edge of the waste weir tower. Its section is 4¾ sq. m., and its gradient of 2·17 per 1,000 is dimensioned for a maximum flow of 10 cb. m. per second, corresponding to a horse-power of 36,000. The entrance from the lake is commanded by a series of three sluice gates, one behind the other, and placed at the bottoms of two shafts. The first is of immensely strong build, and no great care is taken to make it perfectly watertight. It is intended as an absolute protection against full water pressure under the maximum head of 25 m.; and it can only be raised when relieved of this pressure by the opening of a small door inserted in it. At the tops of the two shafts are two small guard houses containing winch gear, whereby the sluice gates are raised and lowered by rods and steel ropes. Behind this first gate comes an iron fence in the form of a sack, which catches all flotsam that may have passed the outside grating, and which can be raised through the shaft to the surface for emptying and cleaning. At the foot of the same shaft, 5 m. beyond this first gate, comes a second hinged valve built in two independently movable side-by-side halves. Behind this, at a distance of 13 m., and at the bottom of the second shaft, is a third gate, also hinged. These two last are of different constructions, the last having for its object the exact regulation of the flow desired at any time, and being therefore movable with great facility and balanced so far as water pressure is concerned, while the main duty of the former is to keep the tunnel free of water for inspection and repairs, for which purpose it is kept close to its seat by the water pressure. Fig. 2 is a section of the guard houses, the two shafts, the three valves and the beginning of the tunnel.

This tunnel is cut through the solid rock of the precipitous south face of the Wiggis mountain for a length of 4·1 km. Where it emerges it makes a watertight concrete joint with three welded steel flume pipes, which descend rapidly to the power house. A guard-house, or "Wasserschloss," is built at this issuing point, which is accessible only by means of a rope railway built up the precipice. Here are installed a continuous autographic water meter, as also other valves, one in each pipe, which can be operated electrically from the power house below. There is also constructed what may be called a gigantic relief valve.

This consists of two long galleries cut in the rock, one at a level of 3 m. above the tunnel and the other about 32 m. higher. These two act as water tanks. The lower

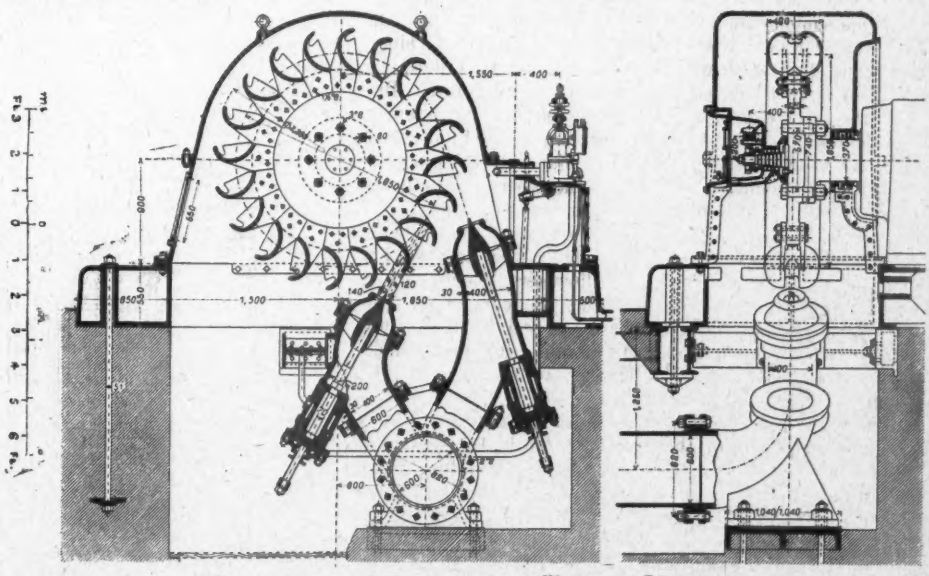


Fig. 7.—Sectional Views, 6,000-H.P. Wheel at Löntsch.

one is normally full and is occasionally emptied by its yielding a small temporary extra supply due to quick action of the turbine governors. The free water level in this gallery, or immediately above it, is determined by the flow through the principal tunnel, this flow being due to the gravity difference between this level and that of the surface of the lake. An oblique gallery is cut through the rock to connect the lower and the upper gallery, and the water

level rises in this when the flow to the turbines is quickly stopped or largely decreased. Thus serious pressure arising from the stoppage of momentum in the enormous mass of water flowing in the long tunnel is prevented. This flow is slowly stopped by the gradual decrease of the head producing it, this decrease being due to the rise of the water in the passage leading to the upper gallery. The upper gallery opens to the atmosphere over a lip or small waste weir at the level of its roof. This arrangement of two water tanks formed as two long galleries cut out in solid rock, the upper gallery having a top outlet to the atmosphere, thus acts as an air vessel or a buffer in which the elastic increase of pressure is due, not to air compression, but to a rising head of water.

Fig. 3 is a view of the interior of this Wasserschloss where tunnel and steel tubes join, taken before the third tube was laid.

In the 4 km. length of the tunnel there are cut two adits or cross galleries running out to the mountain face. These were cut for the purpose of carrying on the work of tunnelling from these two intermediate points as well as from the two ends, as also for the purpose of draining the tunnel during its construction. One of these is maintained permanently as a means of emptying the tunnel for inspection. From its mouth a welded steel flume tube descends the face of the cliff to the bed of the river Löntsch ; and alongside of this tube there is built a permanent service staircase.

Fig. 4 shows the power house, the Wasserschloss, and the three high-pressure flume tubes. These pipes are $1\frac{1}{4}$ km. long, and are very heavily anchored in section lengths to the rock. Below each anchorage there is a brass-lined and rubber composition-packed expansion joint. In spite of the scorching summer sun, and the great cold in winter, there is little variation of temperature in the metal of these pipes, the temperature being wholly governed by the waterflow, and hardly at all by the external exposure to sun and frost. But the water is, of course, cold in winter and warm in summer, and the result is that there is a maximum actual movement of nearly 5 mm. in these expansion joints. If the pipes are emptied in hot summer weather, the movement will be much more than this ; but this has not yet been necessary. The first three lengths of piping are very steep, the gradients being 986, 817 and 764 per 1,000 ; the lengths are each about 120 m., and the diameters 1,350, 1,275 and 1,200 mm. Beyond these the gradients of the two remaining much longer sections are 116 and 124 per 1,000, the diameters being 1,125 and 1,050 mm. The metal thickness varies from 8 mm. at the top to 28 mm. near the power house.

The fall from the Wasserschloss to the turbines is 325 m. The bed of the river Löntsch is immediately in front of the power house, as seen in fig. 4. The flume tubes are carried round the end, and along the front of the house before they enter it. Thus, if one of the pipes bursts, the power house would not be flooded ; the waste water would flow direct with the tail-races into the river bed.

Fig. 5 gives a half-plan and a cross section of the power house. The arrangement is eminently simple, and the whole installation is beautiful in its compactness, quietness and cleanliness. There are six units ranged in a straight line along the main hall, each being nominally of 6,000 H.P. The master control switchboard stretches across the east end of this hall 5 m. above the main floor, and commands a full view of every part of the machinery. The main switchboard and bus-bars extend along the full length of the north side, in an outbuilding from the main hall. They are, therefore, placed well out of the way in complete security from risk of any flooding due to possible burst pipes or turbine casings. The lightning protection is erected in the roof of a central further extension of the building. The transformers are ranged in a row in the basement inside and along the north wall of the main hall. Each of the three great flume tubes feeds two turbines by branch pipes entering from the south ; and the common tail-race for all

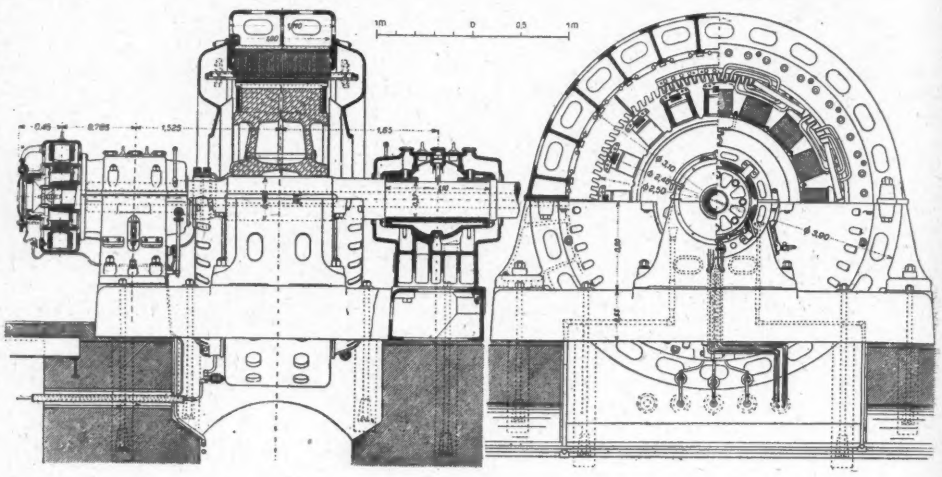


Fig. 8.—Brown, Boveri 5,250 k.v.a. Three-phase Generator, Löntsch Station.

the turbines runs along the south side of the building inside the great hall. The dimensions of this hall are only 16 m. wide by 54 m. long, and from its unencumbered appearance one is tempted to think that it has more free floor space than space occupied by machinery.

Fig. 6 is a photographic view showing fully one unit and a part of a second unit. The turbines are 6,000 H.P. Pelton wheels built by Th. Bell & Co., of Kriens. Two sections of this machine are shown in fig. 7. Each wheel is acted on by two jets, and takes 1,700 litres per second when running at 375 R.P.M. They are governed by the central diminution of the cross section of the jet through the thrusting forward of the "needle," this being operated by an oil-pressure servomotor fitted directly round the end of the "needle" spindle. The governing mechanism is so arranged that it operates upon one jet one or two seconds before it acts upon the other. This is a recent improvement, which has raised very

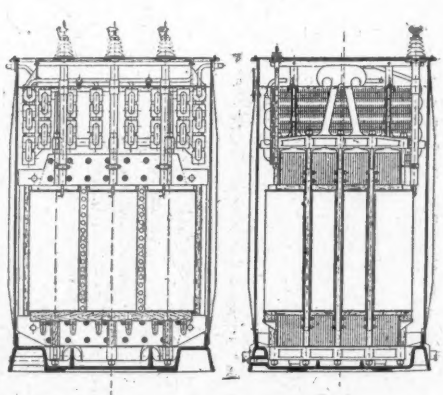


Fig. 9.—4,600 k.v.a. Transformer for 8,000/27,000 Volts.

considerably the mean efficiency of these wheels. The oil servomotors are started into action by a centrifugal ball governor. At the same instant that they commence moving the needle, a large by-pass valve is opened by another servomotor, which permits part of the water flow to pass straight to the tail-race. This prevents resurgent waves of pressure up the mains caused by too sudden stoppage of the flow, and the use of this by-pass has raised in a very large degree the possible quick governing of these large wheels.

The by-pass valve is closed a few instants after opening, but gradually, by the action of a cataract, whose speed can be easily regulated in the ordinary well-known manner.

These turbines maintain over 80 per cent. efficiency from 1,200 to 7,000 H.P., and attain a maximum efficiency of 85 per cent.

All the other regulating valves and mechanisms are throughout moved by oil servomotors, and a special set of oil pumps gives a copious supply, through an accumulator, of oil at pressures of from 375 to 450 lb. per sq. in.

The generators, built by Brown, Boveri & Co., are three-phase. Their output is 5,250 K.V.A. at 8,000 volts and 50 periodicity, the speed being 375 R.P.M. Their general construction is shown in fig. 8. They have 16 cast-steel rotor poles, cast on the core, with 2,480 mm. diameter over the pole faces. The rotor is in two symmetrical halves. Over the poles are placed 96 windings, held fast by laminated pole-shoes. The external casing diameter is 3,900 mm. The main bearing is 370 mm. diameter by 1,100 mm. length. As calculated the generator losses are as follows :—

Full load	$\cos\phi = 0{\cdot}8$	$\cos\phi = 1$
Stator iron	87.0 KW.	84·0 KW.
Stator copper	24·5 „	15·7 „
Field copper	36·5 „	14·3 „
Bearing friction and ventilation	30·0 „	30·0 „
	178·0 KW.	144·0 KW.

Efficiency $\frac{178}{4{,}200 + 178} = {\cdot}958$. With $\cos\phi = 0{\cdot}8$

„ $\frac{144}{4{,}200 + 144} = {\cdot}966$. „ $= 1$

They have 20 ventilation radial passages, each 10 mm. wide. The 96 stator teeth are open, and so formed that the windings are easily laid in place. These are so designed that the tension in all three phases remains equal. The formers for the windings are made of copper sheet and are fastened in place by wooden wedges. Each consists of six copper sheet windings of 145 sq. mm. cross-section, and the current density is 2·62 amperes per sq. mm.

The exciter is mounted overhung upon the end of the shaft. It has eight poles and generates 225 amperes at 200 volts.

There are two sets of transformers. One of these, shown in fig. 9, raises the 8,000 volts of the generator to 27,000 volts, and is of 4,600 K.V.A. capacity.

The other, seen in fig. 10, raises it to 48,500 volts, and is of 5,250 K.V.A. capacity. These transformers were also supplied by Brown, Boveri & Co.

They are oil insulated with water cooling. The smaller size is built of 0·3 mm. thick sheets; the larger of 0·4 mm. thick sheets of special soft quality. Both are star connected. In the high-tension transformer the pressure between contiguous windings is limited to 450 volts. The weights of these transformers are as follows :—

	4,600 kva.	5,250 kva.
Transformers	18,500 kg.	12,280 kg.
Casing	3,300 „	2,470 „
Oil	4,500 „	4,400 „
	26,300 kg.	19,150 kg.

Their energy efficiencies and voltage losses are as follows :—

	4,600 kva.	5,250 kva.
Full load efficiency	98·56 %	98·95 %
Half „ „	97·80 %	98·85 %
Voltage drop $\cos\phi = 1$ ...	0·43 %	0·62 %
„ „ „ $= {\cdot}8$ ...	1·29 %	3·0 %

The rise of temperature above that of the cooling water is from 45° to 50° C.

The 27,000-volt system is fed from the first three generators, and has two outgoing lines. The 48,000-volt system is fed from generators Nos. 4, 5 and 6, and has three outgoing lines. There is also an 8,000-volt network, usually fed by generator No. 3, with five outgoing lines. Each of the high-tension bus-bars consists of two bars coloured "white" and "black," and these can be used either independently or connected as a ring.

Each portion of the high-tension systems is protected by automatic high-tension oil switches, two-poled in front of the bus-bars and three-poled in front of the out-going lines, with maximum relays. The bus-bars are so divided that each generating unit can be connected direct to the neighbouring out-going line without connection to any other part of the whole system. All the outgoing lines are carried to the roof where they are protected by horn and induction coil lightning apparatus.

Each of the six generators can be disconnected from its transformer and coupled direct to the 8,000-volt bus-bar; but in ordinary working this bus-bar is disconnected and lies dead. This bar is used for testing the units separately, when they work upon a water resistance suspended in the tail-race of the turbines. The arrangement thus also permits the 8,000-volt network to be fed from any one of the generators other than No. 3, which is its usual source of energy.

The Löntsch and the Beznau generators are usually

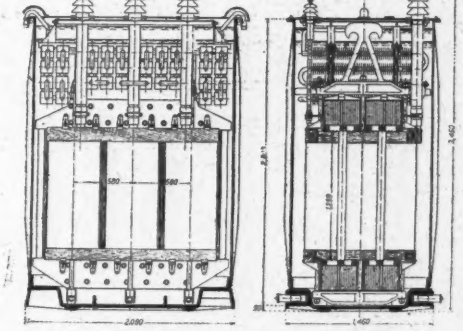


FIG. 10.—5,250-K.V.A. TRANSFORMER, FOR 8,000/48,500 VOLTS.

worked in parallel, and this without difficulty. If the connection between the two stations is accidentally broken, the parallel working can be re-established in a very short time. Also at night time, when the load is small, the whole area can be fed from either station while the other lies idle.

Again, a great part of the total load at any moment can be transferred from one to the other station almost instantaneously. The stations have been frequently tested in this respect. For example, in one test 3,500 KW. was thrown from the Löntsch works on to the Beznau station within two minutes and without the consumers becoming aware that anything had happened.

The whole scheme of this extremely fine work and of its linking up with Beznau, so as to increase the output from this last centre by 80 per cent., is due to Engineer A. Nizzola, director of the "Motor" A.G. The details were worked out by Engineers Dübendorfer, Brodawski, and Ehrensperger.

The technical world owes to these engineers one of the most beautiful examples of completely safe and highly economic hydro-electric engineering, worked out under physical conditions which for 20 years were considered such as to preclude the possibility of any useful result.

Cable Manufacture in Hungary.—As previously announced, the development of the demand for cables in Hungary has induced the directors of the Ganz Electricity Co. to decide upon the erection in Budapesth of a new cable factory in which the Siemens-Schuckert Works will also be prominently interested. The establishment of the factory is to be commenced in the near future, as it is hoped to participate in the supply of cables for the new electricity works to be erected in Budapesth. The new undertaking will be a competitor of the Pressburg Cable Works Co. and the Felten and Guilleaume Co. The Pressburg Co. recently increased its share capital from £100,000 to £200,000, and the Felten and Guilleaume Co. has resolved to raise its share capital from £62,500 to £83,000 in order to meet the threatened rivalry, additional shares having been taken over by a syndicate headed by the Pesth Hungarian Commercial Bank.

THE BRITISH ASSOCIATION.

On Wednesday evening, in the Town Hall at Portsmouth, the British Association for the Advancement of Science commenced its 81st annual meeting. This is the Association's first visit to Portsmouth. The Connaught Drill Hall has been fitted up as the reception room and for general committee rooms, &c. Sections "A" (Mathematical and Physical Science), and "G" (Engineering), are meeting only a few steps away, in the Municipal College.

After the customary preliminaries had been performed on Wednesday, Sir Wm. Ramsay delivered his presidential address, to which, as well as to that of the Chairman of the Chemical Section, delivered yesterday (Thursday) morning, we allude below. Prof. J. H. Biles, LL.D., D.Sc., M.Inst.C.E., in his opening address to the Engineering Section, dealt with the rolling of ships, and accidents to ships at sea, the causes of which it may be are never fully revealed. The varied programme of papers in the Engineering Section suggests that the proceedings of the Section may be more interesting than has sometimes been the case.

Sir William Ramsay prefaces his address with a few reminiscences of earlier scientific bodies. The Royal Society, founded under the name of the "Invisible, or Philosophical College," about 1645, was the first of these, and later there separated off from it many others, such as the Linnæan Society, 1788; the Geological Society, 1807; and, later, the Society of Antiquaries, the Chemical, the Zoological, the Physical, the Mathematical, and many other Societies were founded. The foundation of the Royal Society was commemorated by a poem, one verse of which Sir William Ramsay quotes, though we shall refrain from reproducing it.

The first meeting of the British Association took place 80 years ago, at York, and Earl Fitzwilliam was the President. At that time there were but few workers in scientific subjects, but as the opportunities for discussion and exchange of thought between them increased, so also progress was made. Lord Playfair said, in 1885, at Aberdeen, that it seemed as if human progress and scientific thought were alternative terms in the history of civilisation. This is, as Sir William Ramsay describes it, an echo through the ages of Roger Bacon's utterance in 1250 in praise of experimental science.

Experimental science was in disfavour after Bacon's day, however. It was considered degrading for a philosopher to do more than reason out his theories. Whether it was that resort to experiment was considered to throw doubt upon his mental ability we do not know, but such was undoubtedly the case.

Engineering has now made such strides that the question, "Is it possible?" has been replaced by "Will it pay to do it?"

Sir William Ramsay then deals with scientific education. He laments the fact that in England this has been made a local and not an Imperial question. Instead of half-a-dozen first-rate institutions of University rank, there are half-a-hundred, in which the departments are necessarily understaffed, the staffs are mostly overworked and underpaid, and the training given is not that for captains of industry, but for workmen and foremen. "Efficient captains cannot be replaced by a large number of fairly good corporals." The quotation marks are Sir William Ramsay's. With the last remark we think no one will fail to agree, but we are quite sure that there are in the United Kingdom the desired half-dozen institutions of University rank. And in scientific working the captain of industry must work up to his position, and must have a knowledge of the work not only of the corporals, but of the more humble troopers. This, of course, is not the case in the military profession, and it is time that scientists got rid of the silly habit of borrowing terms from a profession so dissimilar to their own as that of arms.

Sir William Ramsay next gives his views on scholarships, and we shall indicate what these are by quoting his words:—

"To induce scholars to enter these institutions [the half-hundred before referred to] they are bribed by scholarships, a form of pauperisation practically unknown in every country but our own; and to crown the edifice, we test results by examinations of a kind not adapted to gauge originality and character (if, indeed, these can ever be tested by examination), instead of, as on the Continent and in America, trusting the teachers to form an honest estimate of the capacity and ability of each student, and awarding honours accordingly.

"The remedy lies in our own hands. Let me suggest that we exact from all gainers of University scholarships an undertaking that, if and when circumstances permit, they will repay the sum which they have received as a scholarship, bursary, or fellowship. It would then be possible for an insurance company to advance a sum representing the capital value, viz., £7,464,931, of the scholarships, reserving, say, 20 per cent. for non-payment, the result of mishap or death. In this way a sum of over six million pounds, of which the interest is now expended on scholarships, would be available for University purposes. This is about one-fourth of the sum of twenty-four millions stated by Sir Norman Lockyer at the Southport meeting as necessary to place our University education on a satisfactory basis. A large part of this sum should be spent in increasing the emoluments of the chairs; for, unless the income of a professor is made in some degree commensurate with the earnings of a professional man who has succeeded in his profession, it is idle to suppose that the best brains will be attracted to the teaching profession."

We presume that all remuneration should be a reward of labour, application and diligence. A scholarship is undoubtedly the reward of labour, and certainly ranks as earned money. Fellowships have been in existence at Oxford and Cambridge for centuries, and the pecuniary reward of learning is a well established principle where the wealthy classes are concerned. But the scholars, to whom the financial assistance is absolutely necessary if the "captains of industry" so desired by Sir William Ramsay are to be produced, are to pay the money back again, so that the professors, who are already more highly paid than in many continental countries, may have it. Capitalise the scholarships, says Sir William, build and staff real universities, and then—and then what? Why, nobody will be able to go into them, and they will be white elephants. Many pessimists are to be found who deplore the building of universities in our great provincial cities, though some are richly endowed. The reason is that there are no students, or too few. And there is no room for doubt at all that a university education is a costly thing, and Sir William Ramsay is barbarically out of date in calling the endowment of the student whose financial position is not strong, "pauperisation."

Examinations are certainly imperfect as a method of awarding honours. Yet who is it that has a great deal to do with the alteration of the mathematical requirements in the subsidiary papers at London lately, in some cases against the advice and recommendations of the examiners in the honours subjects? None other than Sir William Ramsay. Surely a man occupying his highly influential position should be able to start us on the road which shall lead away from the examination system. Yet the trend of modern English qualification is examinations, examinations, and more examinations, until even our own Institution contemplates the starting of an examination system; and without examinations, what is to become of the external student, who, in his own time and at his own expense, works up his abilities to degree standard? Destructive criticism is easy; what is wanted is a definite constructive policy.

Having expounded his views on educational policy, Sir William Ramsay reviews the losses of the Association during the year; some noted names have been removed from its rolls by death. Among those to whom he refers we may mention Sir Francis Galton; Prof. Story Maskelyne; Dr. Johnstone Stoney; Prof. Van 't Hoff, of Berlin; and Prof. Cannizzaro, of Rome.

Sir William then proceeds to the consideration of ancient and modern views regarding the chemical elements. This interesting theme leads him to the subject of radium and its products, the question of transmutation and of allotropy, as to which many diverse views exist in the chemical world.

The energy of disintegration of radium and its products takes him to important reflections on the matter of our own coal supply, and it is interesting to find that Sir William Ramsay's views coincide with those of the leaders of thought in the electrical world, as to the building of works at the pit mouth, and transmission of energy by electrical means.

He thinks we should start a permanent Commission to take stock of our coal annually, as is done in America, and this Commission should keep abreast with the diminution of the stores of natural energy, and take steps to lessen its rate. He suggests penal legislation to prevent waste, and helpful legislation for suggesting and financing improved methods.

The conclusion comes with an appeal for the study of pure science, without regard to its applications. While remembering the world-wide utility of this course, we should not fail to bear in mind that it is our duty first of all "to strive for all which makes for the permanence of the British Commonweal."

Prof. Walker, who, as our readers may be aware, is the professor of chemistry at University College, Dundee, has chosen as the theme of his address to Section B (Chemistry) the subject of Theories of Solutions.

In opening the address, he refers to the discussion on the nature of solutions which took place at Leeds 21 years ago, the meeting at which this occurred having constituted Prof. Walker's first experience of a British Association meeting. His use of the epithets "great" and "lively" in speaking of the discussion shows that it impressed him keenly, and he now indicates the position of the question at the present time.

He considers this procedure the more appropriate, as van 't Hoff, the great founder of the modern theory of solutions, died this year. Twenty-one years ago his theory was only four years old, and he had hoped to attend the present meeting as he did that one which contained the seed of inspiration which has now blossomed into Prof. Walker's address. Although his wish was not permitted to be fulfilled, his ideas are included in the scientific equipment of chemists of to-day, and the quantitative idea of osmotic pressure will always be to the theory of solution what the quantitative idea of the atom is to chemical composition and properties. Emphasising the fact that chemistry is a quantitative science, Prof. Walker quotes the well-known words of Lord Kelvin, to the effect that unless you can measure what you are speaking about, and express it in numbers, you are only at the beginning of knowledge, but have not yet reached science.

A general theory of solutions must be applicable to all solutions—to those in which the solvent and the solute are merely intermixed, as mixtures of saturated hydrocarbons, or of inert gases in the liquid form, as well as to those in which chemical combination occurs, as in the case of water and sulphuric acid.

For the purpose of illustrating the effect of solvents on a dissolved substance, Prof. Walker gives a series of interesting observations on the solution of iodine in a number of colourless solvents. The vapour of iodine is violet in colour, and if unaffected by the solvent, we might reasonably expect the solution to have the same colour as the vapour at equal concentration. The solution of iodine in carbon disulphide is violet-hued, but the solution in water is brown. In the indifferent hydrocarbons, and in chloroform, the colour is violet, but in methyl or ethyl alcohol it is brown. The rough conclusion to be drawn from these facts is that in the case of saturated hydrocarbons, chloroform, carbon tetrachloride, and carbon disulphide, there is little effect of the solvent upon the iodine, whereas in the case of water and the alcohols, there is considerable effect, probably of the nature of combination, since in all the solvents two atoms of iodine seem to be associated in the molecule. In dilute solution in glacial acetic acid, in the cold, the colour is brown. At boiling point the colour changes to pink, indicating dissociation at 100° C. of the compound stable at low temperatures.

Van 't Hoff's osmotic pressure theory is applicable to all cases, including mixtures of gases, mixtures of inert liquids, and mixtures such as that of sulphuric acid and water. Moreover, so long as the solutions considered are dilute, simple relations connect the osmotic pressure with other easily measurable properties. It has been unfortunately the custom to oppose the osmotic pressure theory of solution to the hydrate or solvate theory. The solvate theory, Prof. Walker says, is not a general theory, and is, further, perfectly compatible with the osmotic pressure theory. The solvate theory stands, in fact, upon the same plane as the electrolytic dissociation theory of Arrhenius, with regard to a general theory of solutions. The former can tell us nothing about solutions in which one or both of the components are inactive, just as the latter can tell us nothing about non-conducting solutions.

There has of late been a tendency to belittle the importance of the conception of osmotic pressure in some thermodynamical quarters. Admitting that it may be dispensed with from the mathematical thermodynamic point of view, Prof. Walker questions whether the cultivators of the thermodynamic method would ever have arrived at Van 't Hoff's results. His conceptions have given a great stimulus to thermodynamics in relation to chemistry.

It is open to an investigator to choose whatever method of working is most suitable to himself. The teacher is obliged to choose that method which is most clearly intelligible to students, and which contains the least likelihood of giving rise to misconceptions. Thus, though the thermodynamic method is mathematically more elegant and in a way simpler, it affords less opportunity than the osmotic pressure method for the student to submit his methods to any practical check or test, and would lead frequently to error and confusion. Prof. Walker is careful to say that this is in no way due to mathematical incapacity on the part of the student. The excellent opportunities now offered to students in connection with mathematics have obviated that. It is in critically scrutinising the conditions under which each equation used is applicable that the difficulty lies.

Of the mechanism of osmotic pressure, nothing is yet known, but great advances have been made in the practical measurement of osmotic pressure in recent years. Though experimental difficulties are enormous, Morse and Fraser have carried on, and are carrying on, in America, admirable work in this direction. America has also produced H. C. Jones, A. A. Noyes, and Van Laar, all of whom have done valuable work in experimental and theoretical directions. They have shown how many substances may be made amenable to mathematical treatment, even when the state of dilution is not so great as in the simple cases taken by Van 't Hoff.

The outstanding problem in the domain of electrolytic solutions is to show why strong electrolytes are not governed by the same laws as weak electrolytes. The formula known as Ostwald's dilution law is strictly applicable to solutions of feeble electrolytes, but to solutions of strong electrolytes it is altogether without application. To the law of mass action there are many exceptions. The enumeration of them invariably occupies several lectures in any course upon physical chemistry.

Explanations have been attempted. Efforts have been made to show why the difference should exist. These have in general been based upon consideration of the behaviour of the ions in the solution. Prof. Walker wishes to draw attention to a point of view which has not, so far as he is aware, been fully considered. Is it the ions in the solution which are abnormal, or is it the non-ionised substance? The view which he proceeds to deduce reasons to support, and which has been reached by Noyes and others, is that it is the non-ionised portion of the electrolyte which exhibits abnormal behaviour.

It is natural to attribute everything to the ions, because they are in general the active constituents of an electrolyte. Prof. Walker goes on to show that ionisation may in some cases be normal, while the recombination is abnormal. In other examples, the reverse may be the case.

If it were possible to measure directly the velocity of either operation, it would at once be easy to select the proper equilibrium formula. These velocities are, however, unfortunately so high as to be beyond our powers of measurement.

The assumption may, Prof. Walker thinks, be justified

that if in a given solution a substance has normal activity with regard to one reaction, it has normal activity with regard to all reactions in which it can take part in that solution, while if its activity is abnormal in one case, it is abnormal in all.

Ammonium cyanate can be transformed into urea in aqueous and aqueous-alcoholic solutions at rates which can be easily measured. Prof. Walker has himself experimented on this reaction, and he finds very strong evidence that in the case of the abnormal electrolyte, ammonium cyanate, the abnormality of the ionisation equilibrium is entirely due to the non-ionised portion. Since ammonium cyanate is no different in regard to its electrolytic conductivity from the hundreds of other abnormal binary electrolytes with univalent ions, he is disposed to conclude that it is to the non-ionised portion in general of these electrolytes that the abnormality is to be attributed.

He remarks that the conclusion is not new, but has not been sufficiently emphasised. Nernst's principle of the constant ionic solubility product tends to show that the ions act normally in solution. Summing up, Prof. Walker says that in the equilibrium between electrolytes agreement will be obtained between theory and experiment whether we use the mass-action law, or an empirical law such as van 't Hoff's dilution formula, provided only that we attribute the abnormality to the non-ionised portion of the electrolyte. The problem of *why* certain electrolytes should be normal, and others abnormal, is matter for further investigation and research.

The theory of solutions ought to provide a suitable basis for the general calculation of hydrates. That hydrates exist in some aqueous solutions is undoubted, but no general rule or method exists for determining what the hydrates are, and in what proportions they exist. The ionic theory does not indicate, save in aqueous solutions, what the ions are, and how great is the degree of ionisation. Clausius enunciated the theory of electrolytic dissociation, or free ions, in 1857, but until Arrhenius introduced measurable quantities into the doctrine, it was barren. As soon as a simple quantitative principle is developed for hydrates in solution, that doctrine will become fertile.

Prof. Walker draws to a close by pleading that the irrelevant and intemperate things said and written by wholehearted upholders of the osmotic pressure and electrolytic dissociation theories on the one hand, and of the hydrate theory on the other, should be forgotten. Those who remember the discussion between Sir J. J. Thomson and Prof. Armstrong last year will realise that there must, of course, be much in each of these views. The plain man's conclusion is, naturally, that the truth must lie in a combination of both, and it is satisfactory to find that this is also the conclusion arrived at by the learned President of the Section.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY *cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.*

Oil Engine Fuel.

We have read with interest the paragraph upon oil engine fuel, appearing in the issue of August 4th of the ELECTRICAL REVIEW.

While there are, unquestionably, difficulties in handling oil having an asphaltic base, still there are engines on the market which are built to deal with it effectively. The alternative system of retaining some 20 per cent. of the heavier or tarry portion of the above fuel in an external vaporiser cannot be considered a satisfactory solution, for it is very evident that, unless great care is taken to maintain the correct vaporiser temperature, a portion of the heavier constituents of the oil will enter the cylinder, and "gumming" will ensue sooner or later. The only practicable way to deal with tar oil is to consume the whole of it within the cylinder; and with an engine of suitable design, this would offer no difficulty. In support of this statement, we should like to bring to your notice the Ruston patent complete combustion oil engine, which has been sold in large numbers within the last two years, and has worked so successfully with residue oils of all kinds, including in a number of cases those having an asphaltic base, that we have had many repeat orders. This engine works with great economy and reliability, and will run for long periods with the minimum of attention, and, what is of salient importance, without cleaning; while its economy is effected without the aid of an air compressor with its attendant complications, or a very high compression pressure.

We have long recognised the demand for this type of engine; and in placing the complete combustion engine on the market, we are offering one which is able to handle, in an efficient manner, cheap fuels which are unworkable with the large majority of engines.

Ruston, Proctor & Co., Ltd.

Lincoln, *August 24th*, 1911.

Metal Lamp Patents.

Our attention has been called to a statement under the above heading appearing in your journal of the 18th inst., addressed to you by the Osram Lamp Works, Ltd., to which is appended a notice of an order made in reference to an action brought by that company against the British Tungsten Lamp Co., Ltd.

As one of the various manufacturers referred to in that letter, against whom litigation has been commenced, we desire to call your attention to the fact that the order referred to was made with the consent of the defendants, who took no steps to defend the action.

The business of the British Tungsten Lamp Co., Ltd., was in the hands of a Receiver for the debenture-holders, who did not feel justified in contesting the proceedings. The point is material, as your correspondent's letter might convey the impression that the order was the outcome of an investigation by the Court.

We may add that the proceedings instituted against us are being defended, and we are content to await the decision of the Court.

"Z" Electric Lamp Manufacturing Co., Ltd.
KILBURN BROWN & CO., *Managers.*

London, E.C., *August 23rd*, 1911.

Insulating Properties of Leatheroid and Presspahn.

In your issue of the 18th Mr. Sack throws doubts on the deductions that I drew as the result of my experiments. I think that it is quite clear that I was comparing the two substances as they exist, *i.e.*, under normal conditions and after being exposed to damp atmosphere. Thus, under these conditions presspahn is undoubtedly superior to leatheroid.

After treating with insulating compound I found, as Mr. Sack seems to have found also, that leatheroid has the higher puncturing voltage. This is clearly indicated by my figures.

If Mr. Sack's deductions are drawn after treating both materials, then his experiment and mine are on quite different lines.

Without treating, presspahn is superior; that is what I wished to convey.

D. H. Ogley.

August 24th, 1911.

Cost of Electric and Acetylene Lighting.

I have received a booklet which apparently has been widely circulated by a firm of acetylene contractors.

In dealing with the fuel costs of various illuminants, the following statements appear amongst others of similar purport. I only quote the most glaring:—

"*Electricity.*—Six 16-C.P. lamps use in eight hours 3 B. of T. units, which at 5d. per unit = 1s. 3d.

"*Acetylene.*—Six 16-C.P. burners use in eight hours 16 C.F., or 3½ lb. of carbide, which at 1½d. per lb. = 5¼d."

These statements are obviously misleading, and are not,

in my opinion, fair trading. Can anything be done to check this sort of thing?

As the booklet deals almost entirely with country house lighting, it is only fair to compare with electricity on the same basis, and taking the commonest case of a paraffin engine, small dynamo and storage battery, the figures appended hereto are, I think, very moderate, and bring out a very different result to the aforementioned statements.

Further comments might be made, but they are, I think, needless.

Six 16-C.P. low-voltage metallic-filament lamps at 18 watts for 8 hours = 864 watts, say, ·9 B.O.T. unit = 1·2 H.P.-hours.

Taking battery efficiency = 60 per cent., and dynamo efficiency = 75 per cent., it gives B.H.P.-hours required from engine = 2·67.

Taking engine consumption at 1 pint per B.H.P.-hour, and paraffin at 6d. per gallon, gives

Fuel cost of six 16-C.P. lamps for 8 hours = 2d.

Even comparing with a town supply at 5d. per unit, the cost comes out at 4½d., instead of 1s. 3d., as stated.

Scottish Contractor.

August 24th, 1911.

Tests of Lamp Shades and Reflectors.

With reference to our article on "Distribution and Efficiency Tests on Lamp Shades and Reflectors," published in your issues of July 7th and 14th, Messrs. Holophane, Ltd., have written to us pointing out that some readers have assumed, from the figures given, that the Holophane shade possesses no advantage over the ordinary opal type.

As we took every precaution to avoid photometric errors, we are confident that our results are correct within 1, or at most 2, per cent., but we do not wish these to be considered as in any way depreciating the excellent qualities of the Holophane shade.

The choice of designs available giving various definite polar distributions, the excellent screening and high efficiency of these shades, together with the uniform illumination produced even when used singly, render them, in our opinion, one of the most perfect forms of shade that has yet been introduced.

The object of the article was, as stated therein, to give information concerning the shades in common use, and this we have attempted to fulfil without unduly favouring any particular type.

Leonard Murphy.
H. L. Morgan.

London, E.C.

Representatives Abroad.

The excellent leading article on the above subject which appeared in your issue for July 14th, though primarily directed to a consideration of the needs of our Colonial markets, contains much that is equally pertinent to the question of representation here, in India.

In an article which appeared in the Electrical Review, Vol. LXVII, page 474, I touched on the subject of the qualifications required for successful personal representation in India, and it is interesting to note that your article endorses the general propositions which I then ventured to put forward.

It is gratifying to note that you lay special stress on the necessity for thorough technical knowledge on the part of the engineering representative. It might be thought that it is superfluous to labour a point which is almost self-evident, were it not for the fact that, even now, it is possible to find as representatives of engineering firms gentlemen who are "salesmen" and nothing more.

In England, where salesmen are always within easy touch of the technical department of their principals, such men may show satisfactory results. Here the sales engineer has no such assistance.

It must, however, be freely acknowledged that the great majority of electrical manufacturing firms who have adopted direct representation in India, have laid the above lesson to heart, with the result that our electrical engineering representatives here are, with few exceptions, gentlemen of not inconsiderable technical qualifications and professional standing. Indeed, on this point British enterprise compares very favourably with that of Continental firms, and there are several of our British manufacturers who deserve much credit for the complete and adequate manner in which they have dealt with the problem of Indian representation. It is to be regretted that the harvest is not always proportionate to the labour which has been expended.

Speaking generally, I venture to think that here in India the usual complaint of inferiority to Continental firms in the art of representation cannot be fairly laid to the charge of our manufacturers of "heavy" electrical supplies as far as the *quality* of their representatives is concerned.

In my opinion, unsatisfactory results are often due, not to the sales organisation in Indian itself, but to failure, on the part of the head office of works at home, to fully support and assist the Indian branch. There is often, as pointed out in your leading article, a regrettable reluctance on the part of those at *Home* to carry out suggestions from those *Abroad*. If success is to be attained, it is essential for the head office at home to realise that it is the "man on the spot" who *knows*, and that his opinions and his suggestions *must* be attended to, however much they may be at variance with the preconceived ideas of those at home.

Furthermore, it is essential that the Indian representative should have far wider powers than those accorded to a branch manager at home. He must not be tied by standard instructions which would be good and proper for the latter. He must practically have a free hand to do what he thinks best in the interest of his principals. Often the latter, not unnaturally, shrink from entrusting to a not very senior member of their staff powers little less than those of a director at home.

Further consideration will show that this risk must be faced. Time seldom permits of referring questions home and awaiting replies. Hence the representative must be able to strike a bargain on his own authority.

To firms who are used to a rigid system of centralised control over their sales organisation such freedom will seem repugnant, and even subversive of sound business principles. It is, however, unavoidable. The representative who is under instructions to refer home every question, technical or financial, which is out of the ordinary run of business, will do no good either to himself or to the firm he represents.

Just as in the process of "empire building," the responsibility placed upon officials in distant lands is far greater than those officials would be entrusted with were they at home; so must commerce trust large issues to her pioneers, and, if the right men are selected, that trust will be as well sustained in the latter case as history has proved it to be in the former.

G. E. Wright, M.I.E.E.,
Electrical Engineer, North-Western Railway, India (Lahore).

Lahore, *August 9th*, 1911.

Labour Troubles.

As a reader of the Electrical Review for over 21 years, I protest against your leader of August 18th on the strike, it being unworthy of the *Daily Mail* and unfit for an electrical paper read by all classes of workers. Adam Smith, over a century ago, stated that "all wealth is produced by labour." The generally accepted definition of capital is "that part of wealth that is used to produce more wealth." You state that the strikers are reinforced by every blackguard hooligan, who never has or never will try to do a good day's work. This is wonderfully like the legal definition of a gentleman: "One who lives without working." Legally, a doctor or engineer cannot be a gentleman until they retire from work.

The secretary of the railway workers, four years ago, had instructions for either a strike or recognition of trades unions. He accepted the Conciliation Boards instead of either, and is now a Government official. Workers are free to work or starve. What have men starving a wife and family on 16s. 10d. per week to conciliate about? Your remarks about the community striking against the Guardians are very apt. It costs the Guardians 1s. so that a pauper will

benefit to the extent of 3d., and the strikers not being paupers, and living in houses and paying rates, would benefit 6d. or 1s. per week if they withheld their poor rates.

The Conciliation Act, which was forced on the workers by the Government, works like this. The first important award was given by Lord MacDonell in November, 1909, two years after the establishment of scheme. Disputes followed as to its interpretation, and for a long time the companies refused to ask the arbitrator to elucidate his decision. When, in December, 1910, the managers were finally forced to consult Lord MacDonnell, he declared that the men had been correct all through in their reading of the award. Your statement that the docker gets £3 in a comparatively short time means that, if the docker worked usual office hours, from 9 a.m. till 6 p.m. on five days and on Saturday from 9 a.m. till 3 p.m., with an hour for lunch each day, he would be two weeks earning £3. He would probably have to wait about the same number of hours in order to get the job, and be picked out, like butchers pick beasts, by the amount of beef and muscular energy he appeared to possess. Then you say, "silly girls striking out of sympathy." I have no sympathy with average wages of 7s. to 10s. per week when I know that 100 families per week in Christian England consecrate a daughter to a life of shame.

Tipping, as you say, is a disgrace, and is indulged in by those who aspire to be considered legal gentlemen. The worker should be paid such a wage that he can keep a wife and family without having to bow, beg and scrape to every blackguard hooligan who offers him twopence. This only creates flunkies and more parasites for the workers to feed. The position of the gentleman (legal) and the worker reminds me of big fleas have little fleas on their backs for to bite 'em, and little fleas have lesser fleas, and so on *ad infinitum*. I consider betting on horses or stocks and futures as dishonest as accepting premiums from pupils in the electrical trade, and, as a manager to a supply company, I always refused premium pupils.

Premium.

August 28th, 1911.

[We would suggest, in all seriousness, that our correspondent should carefully read "The Economics of Strikes," by Mr. Harold Cox, published in the September issue of "The Financial Review of Reviews." If this does not give him a clearer conception of the subject on which he holds such irrational, inconsiderate and uninstructed views, then nothing will bring him to a fuller appreciation of ultimate economic facts.—Eds. Elec. Rev.]

I was somewhat interested in "Labour's" article under the above heading in your issue of August 25th. While my sympathies are with "Labour" and the cause he espouses, it appears to me that he is indulging in random firing, and is in reality injuring the cause he wishes to uphold.

Liberty! what is liberty? Liberty in many instances becomes oppression; at the present time a man who is in receipt of good wages is at liberty to spend them practically as he likes; he is at liberty to marry and have a family; he can play the fool, neglect his family, ruin and undermine his constitution, until he becomes chargeable to the rates. But what are the liberties of the men who pay the rates? They are not at liberty to say whether or no they will pay their rates; they are compelled to do that. If this were not so, by sheer stress of economic forces the man who wasted his income would have to mend his ways, *i.e.*, curtail his so-called liberties, or go to the wall, where want and privation would be his ultimate reward.

We prate of the rights of man and individual liberty, very often overlooking the fact that the rights of the ne'er-do-well in many many instances infringe on the rights of the well-doer.

Let me give a quotation from an article that I have before me:—"Germany has a law that provides that if it can be proved that a man is earning a sufficient wage to support those dependent on them, but that he is dissipating that wage by vicious habits, he can be declared a minor, and he is then treated as a child. His employer is told that the wage must be paid, not to the man, but to a guardian appointed by the magistrate of the district in which he lives, who uses it for the support of the wife and children. In England a man who could not get his wage might refuse to work; in Germany the police would see that he did. The District Captains are expected to report at the head office all cases that should be thus dealt with."

This practically has the effect of protecting the liberty of the well-doer, while restricting the liberties of the ne'er-do-well. Comment, I think, is superfluous.

"Labour" must also remember that many men are victims of their own folly. Now, with respect to this, let me touch on "Mental Capacity of the Individual." Between mental capacity and incapacity there is no broad line of demarcation, it is a question of degree. There is no degree, however, of control; it is either absolute freedom or absolute control (lunatic asylum); now, it seems to me that partial supervision and watching of the interests of Nature's weaklings would be beneficial to the nation generally.

In handling problems of this description, it is wise to view things from the stern realities of life, not from the land of dreams and ideals; if you preach false doctrines to the unenlightened multitude, the time comes when the disappointed multitude turns on its would-be protectors and leaders, and rends them limb from limb; at least, this is the teaching of history.

There are times in the lives of each one of us when we compare the dark present with the bright past, and think the majority of other people's jobs are easier than our own.

Whilst not ignoring the valuable services rendered to the general public by the vast body of railway workers, we must not overlook the fact that "over 100,000 of them with 20s. a week or less," include many lads—lad clerks and junior porters, &c., that have to start at something the same as the rest of us; many of them are employed in the country, where conditions are vastly different to those in towns. I have worked in London, also in the country and on railways, and can speak from experience. Space, however, does not permit me to dwell on this as fully as I could, although for the purposes of this article there is no reason why I should. This remark also applies to the question of the "silly girls."

I hold no brief for employers or capitalists; I wish to be impartial. But supposing one Monday an employer called his employés, numbering 500, together, and told them that, owing to better trade, he was going to distribute about an extra £1,000 between them per annum in wages, what would be the feelings of the individual after a week's anticipation and speculation, when they found out that it only meant an increase of 9d. per head per week? I guess many would feel disappointed, and it would take some convincing to make them satisfied and feel that they were being fairly treated, and yet on a capital of £40,000 the same sum would represent 2½ per cent. dividend. We talk glibly of capital, capitalists, dividend and interest; yet how many men in works will borrow money and pay interest of 1d. or 2d. per 1s. per week (? how much per cent. per annum), most probably to put it on a horse or spend in some other useless manner, and yet begrudge a fair interest to the men who find the necessary money so that tools and equipment can be acquired, so that they can be usefully and efficiently occupied to their own advantage.

Again, say a mechanic is paid 9d. per hour, and his employer advances him to 9½d., at the same time the employer, from philanthropic, I will not say business motives, advances his labourer from 6d. to 9½d. per hour—would the mechanic turn round and congratulate and shake hands with the labourer on his good luck? "I don't think." Not while human nature is what it is, and human nature is really at the bottom of the social question; although I believe, as a nation, we are becoming more altruistic, and in that fact lies hope.

SOLIDARITY—capital letters, please. While one or few men may receive an increase in salary and relatively be in a better position than the remainder—when applied to the whole, and that, I take it, is what "Labour" means, relatively speaking, everyone would be in the same position as previously, unless there were a corresponding increase in production. Wages act on cost of manufacture, and anything which acts on cost of manufacture is reflected in the selling price, or, in other words, we should, relatively speak-

ing, have to pay more for the goods we purchased, and this would have the effect of defeating any other advantage we might have gained.

Referring to "Labour's" concluding paragraph: "Humanity is vastly more important than property," and "there is no wealth but life;" are employers alone to blame in this respect? Are all rich people devils, and are all poor people saints? I think not. Do we all direct our energies to the best advantage, or, in other words, spend our money as we should? I think not. I admit that as you saunter through the West End of London you see evidence around you of luxury, idleness and waste, but on the other hand, if you go into the East End of London, you see evidence of economic waste in many ways, and even idleness and luxury of a degraded type. I admit this is the extreme, but take the mean. You see money spent on dress and finery by all classes that would far better be spent on good food and nutriment; the drawing room, dining room and parlour furnished elaborately, while the kitchen, larder, library, or book-case is neglected, and the quiet pastoral pursuits of the country-side are neglected and spurned for the bitter apples of modern town life; and what applies to the individual life applies to the national life.

Oliver Goldsmith, when writing his "Deserted Village," in 1770, plainly foresaw the cause of a great deal of our present-day troubles; let me give a quotation:—

> Ill fares the land, to hastening ills a prey,
> Where wealth accumulates and men decay;
> Princes and lords may flourish or may fade,
> A breath can make them, as a breath has made;
> But a bold peasantry, their country's pride,
> When once destroyed, can never be supplied.

"Labour" says: "You assume that probably much of the trouble arises from sheer economic ignorance," and he remarks, "It does"; but waving aloft the flaming torch of class hatred and enmity will not improve the position; and are any of us past masters in the art of economic laws? Is there not room for improvement in us all?

My views and opinions may not be "Labour's"; I, however, submit them for his consideration, and for the consideration of anyone, either employer or employé, who is interested in one of the most pressing problems of present-day life; and I hope that many are so interested.

A. W. Wyatt.

P.S.—I would also refer "Labour" to my letter under "The Sphere of Government Influence," in the issue of August 18th.

In the recent articles in the Electrical Review regarding the present labour troubles, statements appear to have been made without due consideration from some points of view. The leading article in the issue of August 11th contains the following quotation from John Stuart Mill:—

> When a Government provides means for fulfilling a certain end, leaving individuals free to avail themselves of different means if in their opinion preferable, there is no infringement of liberty, no irksome or degrading restraint.

It is surely obvious that whatever truth or merit this statement may possess, will depend upon the statement at all times and in all respects of a reasonable equity in the relations that exist among the individuals concerned. If there had never been unfairness in the relations between employer and employed, there would probably not have been any occasion for restrictive Government control. Quoting further:—"Those relations—at one time free, or practically free, from Government control—are now hedged about with all kinds of restrictions. The parties are not free to contract one with the other."

Inequitably, no; for that would be still worse restriction. I think it must be admitted that the prevalence of bad conditions, and of injustice, has been largely the cause of Government interposition in these matters.

Again:—"A may not run a factory unless it is open to the view of a Government inspector." Is not this really to protect the liberty of A's employés? What is that in which A is restricted and which he dare not let a Government inspector see?

"B may not employ able-bodied pitmen for nine hours at a stretch in his coal mine."

Is it not rather the pitman who would never have been free from the slavery of the one time 12 and 14 hours' day, had there been no legislation?

"C may not agree with D, for whom he works, that he will take no advantage of the Compensation Act if he meet with an accident in the course of his employment. Are not all these 'infringements of liberty' or 'degrading restraint'"? Can anything more degrading be imagined than that D should desire C to forego compensation for an accident he has met with while in his employ?

Then follows a taking picture of the "humane employer of 15 years ago" sending poor sick Tom his wages. Is it implied that this was the general practice? How many employers of this type were there, and what proportion of the total workers did they employ? Did he likewise for Dick and Harry and others, as well as Tom? It is not on his account that there is a Compensation Act, so much as the other kind of employer whose name is legion.

I was engaged in the office of an industrial undertaking employing over a thousand hands, more than 15 years ago, and in many cases of sickness I do not remember one instance of a workman's wages being sent him during the time he was compelled to be away from duty.

With regard to the statement concerning the National Insurance Bill, that:—"Its only result may be to enable the employer to save that which he would otherwise spend," if this is so, what reason is there to complain from the employer's point of view?

It is easy to say, as we all do, that labour troubles can and should be settled without recourse to strikes and their deplorable accompaniments, but the pitiful feature of the whole matter lies in the fact that conditions that constitute admitted grievances do not get remedied without. It is not the *possibility* of improvement by peaceable means that is in question, but the *actual undelayed accomplishment*. If the nation dallies with reform, then the nation cannot hope to have anything other than revolution as a consequence.

Scrutineer.

Olympia Exhibition.

In my last letter I said I would make full apologies if I were proved to be wrong in my statements as to electric cooking by the Exhibition caterers.

Mr. Butler has since informed me as to the steps that were taken, which probably were not so active as they would have been had the committee been composed of electric cooking manufacturers only, and were not the steps referred to in my letter, but undoubtedly a strong line *was* taken, with, unfortunately, no success, so the committee are entitled to my withdrawal of my criticism of their action.

I do think, however, that the next Electrical Exhibition should be "all electric," though by that time there will be a sufficient number of large electric cooking plants in London to make resistance such as the Exhibition Executive have experienced very difficult.

A. Hugh Seabrook.

London, W., *August 26th*, 1911.

Direct Trading.

Re letter in your issue of August 8th, signed "Wavering," your correspondent is certainly in an untenable position, and must accept one of the two ways out of the difficulty. The first method would be to remain loyal to the trade and respect all its ordinances. The second way would be to supply all and sundry on trade terms, and become "an outsider." The first way should prove the more beneficial, as a feeling exists (in the electrical world) to support firms who study the welfare of the trade. "Trade terms to the trade only," this fact should be widely advertised, and (providing goods and prices are competitive) there is no doubt the trade will support a firm carrying out this policy. The second way is a despicable method of doing business, it is generally stigmatised by the trade and has a train of disadvantages attached to it.; on summation we find—the business done outside the trade (motors) is very limited—the orders do not repeat—the mistakes are numerous (through lack of technical knowledge), which cause loss of

time and expense which a trade quotation does not cover. Subject to circumstances, there are exceptions to the above trade acceptances. Regarding the Contractors' Association's line of action, I have no doubt, if your correspondent forwards the name of the offending firm to the Association, they will send the customary letter, "Telum imbelle sine ictu," await the customary reply, and having received same, await the millennium.

Percy Collins.

August 28th, 1911.

Who Pays?

It has occurred to me during troubles in the coal trade that, if I were a foreigner, I should much like to see the colliery owners try the policy of conceding all the men's demands, and putting up their prices correspondingly. They would no doubt, in order to secure the same profit, have to add more to their prices than the exact extra to which the concessions amounted, because the increased cost of coal would reduce the consumption, particularly the exported portion. Still, I should think it might be done; and it would prove a very instructive lesson. Of course, it would do considerable harm to the country, and I, therefore, do not advocate the policy. My reason for mentioning the coal trade particularly is that it is probably the only one in which the experiment would not certainly prove disastrous to the employers. No doubt we should start by congratulating the men on obtaining their "rights," then we should hold up our hands in alarm at the cost of coal, and curse the owners for their cupidity; and then we should nationalise the mines, though Heaven only knows what good that would do.

I should, however, like to know what objections there are in the case of a strike of municipal tramway employés to taking a poll of the ratepayers to decide whether the demands shall be conceded, and, if so, whether the extra cost should be put on the fares or be borne by the rates, information as to what these would amount to being, of course, given. I think the advantages of this procedure are obvious, but, not being a tramwayman, there may be disadvantages of which I am not aware. Of course it would be useless for a tramway company to adopt this method, even if they could, as the decision would be to concede the demands, the shareholders to bear the cost.

J. S.

August 26th, 1911.

A Question of Trade Practice.

May we ask those of your readers who are in the rubber, cable and electrical material trades to inform us, and your readers generally, whether it is the recognised practice of the trade, when selling pure rubber tape, to include in the weight charged for, the roll of paper that interleaves the layers of rubber? Very much to our surprise we find that it is a very general practice among a certain section of dealers.

If this is general practice, we fancy it will come as a surprise to many of your readers, who, like us, will fail to see the humour in buying wrapping paper at 8s. a lb.

We should also be much interested to know whether such a practice, even if general, is legal.

Importers.

Electric Heating and Cooking Apparatus.

As one actively engaged in selling electrically-heated apparatus, I am much interested in the discussion that is appearing in your columns on the above subject. It is a difficult matter to get this class of apparatus into the hands of people who would really be pleased to use it, and would realise its advantages when once the prejudice against its first cost had been worn off.

The manufacturer cannot do much more than he now does. He has to make and sell the goods at a figure which will stand comparison with similar apparatus using gas. He is expected, by many people, to send out goods on sale or return—to lie in the show room or even in a corner at the back of the storeroom and to remain there indefinitely. He is expected to supply unlimited quantities of expensive advertising matter. He is expected to give long credit, and risk bad debts in a trade that is notoriously worse managed than the average. If this apparatus sold as freely as pills or sauce, and bore the same margin of profit, he might, perhaps, do a little more than he now does.

The contractor cannot afford to devote much energy to this portion of his business. Repeated experience has proved that the cost of actually selling most forms of cookers or heaters is, in the present stage of the industry, considerably greater than the amount of profit that is obtained directly from the sale. He cannot really be blamed if he is content with handing the goods over the counter in response to a made demand in exactly the same manner as a grocer or any other tradesman. Some few contractors are wide awake and active enough to sell a fair quantity, and, where they are able to obtain orders for heating circuits at the same time, they are usually well repaid.

The supply authority is, in most cases, the only possible organisation that can sell this class of apparatus at a profit to itself. Every good iron, cooker or heater is a steady source of profit—profit from the sale of a by-product—a daylight load. At present less than 10 per cent. of the stations in this country appear to be in any way aggressive in developing the use of electricity for heating or cooking purposes, and 10 units per head of population appears to be about the average consumption per year. The contractors really have no cause to complain if the supply authorities relieve them of the responsibility incurred in selling motors, cookers or the like. Hire or hire-purchase arrangements are usually made necessary by the action of the gas companies, and, so long as the contractor has the wiring and the installing to do, he is better off than if he has to sell the complete installation at a cut price and uses the cheapest apparatus obtainable.

Some few authorities have progressed so far as to open a free museum of apparatus, stocked largely at the expense of the hopeful manufacturers. A stronger effort is needed.

Why is it that so many supply authorities do nothing at all to develop the use of electricity? Has any authority lost money through being aggressive?

Manufacturer—Ex-Contractor.

NEW ELECTRICAL DEVICES, FITTINGS AND PLANT.

Leather-Faced Insulating Gloves.

Our attention has been drawn to the excellent leather-faced insulating gloves which the St. Helens Cable and Rubber Co., Ltd., of Warrington, have now been supplying for the last two years, and which we have had the opportunity of inspecting.

Fig. 1.—Leather-faced Insulating Gloves.

The ordinary rubber insulating glove is naturally liable to abrasion in ordinary use, and puncture by contact with sharp projections; the knowledge of this tends to restrain the average man

from using the gloves, except on what appear to be the most dangerous jobs, and this leads to accidents. With the St. Helens Co.'s arrangement of leather facings over the palm of the hand and faces of the fingers, both the wear on the glove and the chance of dangerous punctures are enormously reduced, especially when the glove has been in use for a time. The leather covering also shields the rubber from the effect of exposure to atmospheric changes, and preserves it.

Every glove is tested at either 2,500, 5,000 or 10,000 volts, and labelled to that effect, together with the company's name, and a leather tab is provided to prevent ripping in case the glove is pulled on hurriedly. Both gloves and gauntlets are supplied, in 8, 9 and 10 sizes, and the firm offer to test and inspect, free of charge, gloves of their own manufacture, if sent to them carriage paid.

We understand that several hundred pairs of these gloves have been ordered by the Admiralty, and that during the two years they hove been on the market, no complaint has been received regarding them.

"Tubead" System of Electric Heating.

Messrs. F. A. Wilkinson and Partners, Ltd., of Harpenden, Herts., have recently introduced a patented system of electric heating known as the "Tubead." We illustrate in fig. 2 a 1,000-watt heater on this system, consisting of a seamless steel tube, 7 ft. 6 in. long and 1 in. diameter, in the interior of which is run the heating element, of special type. The tube is complete with connection box and supports, and three degrees of heat can be provided in the single length of tube, if desired. Naturally the first cost of such a heater is very small in comparison with steam or hot water systems, and its convenience, where an electric supply exists, is obviously much greater.

Fig. 2.—"Tubead" 1,000-watt Heater.

New "Graphic" Instruments.

Messrs. Everett, Edgcumbe & Co., Ltd., of Hendon, N.W., have just introduced a "recorder" possessing numerous novel features, and owing to the very great confusion which has so often arisen in the past between, say, a "watt-hour meter" and a "recording wattmeter" (owing to the latter expression being loosely applied to both instruments), they have decided as far as possible to abandon the term "recording," and to speak of a "graphic" ammeter, wattmeter, &c. By this means it is felt that all possible confusion will be obviated.

As showing the very wide range of usefulness covered by these new instruments, it may be said that they could be supplied for practically every purpose, including voltmeters and ammeters for continuous and alternating currents, wattmeters for continuous, single-phase and polyphase circuits, whether balanced or unbalanced, speed and frequency indicators, pyrometers, pressure and vacuum gauges, and, in fact, for any and every purpose for which a graphic record may be required.

Fig. 3 shows the general appearance of a recording voltmeter. It has an exceptionally large glass window through which a long length of record can be clearly seen, and a special spring fastening which affords an absolutely dust-tight joint, and yet, at the same time, is instantly opened with one hand. It is, moreover, so arranged that a padlock or seal can be employed, if thought desirable.

Fig. 4 shows the internal appearance of a moving-coil graphic ammeter. Covering the permanent magnet, and shielding it from stray magnetic fields, is a detachable hood B, which is seen as a "ghost" in the figure. As will be gathered from the illustration, a roll of chart is inserted between spring centres H, above the clock, and passes down under two springs and a toothed guiding-wheel in the centre. Under this latter lies the driving wheel of the clock mechanism. The arrangement is such that the chart cannot possibly slip, and the guiding is so perfect that all tendency to creep to one side or the other is avoided.

Below the clock is a roller L, on which the chart can be made to wind itself up, if required, as it is passed through the recorder. On the right-hand side will be noticed the winding lever D, which owing to the construction of the case, is thoroughly accessible and very conveniently placed. Below this lever are the change wheels K, whereby any desired paper speed can be provided. These wheels are readily accessible, so that any subsequent change in the chart speed can be carried out in a few moments and without the necessity of returning the recorder to the factory. Further, by means of a simple gear-changing device, two or more speeds can be provided on a single instrument, so that the same recorder can be used for widely different purposes. For example, a speed of 1" per hour can be provided for ordinary work, and this can instantly be altered to, say, 1" per minute for use in connection with machine-tool driving.

A special feature is made of a hinged pen-arm, which can be instantly removed for cleaning or replacement. The simplicity of the operation is well shown in fig. 5, which indicates the method of removing it by merely pressing together the two arms of the spring fork G between the finger and thumb. Amongst the advantages claimed for this construction of pen are, besides ease of removal, a constant and readily adjustable pressure on the paper, and the maintenance of a very high insulation resistance between the electrical winding and the pen, which last is a most important point, particularly in connection with traction and other earthed systems.

It may be mentioned in passing that the surface of the chart over which the pen moves is a perfectly flat one, in contradistinction to the curved surface provided in the case of drum and many other recorders.

The pen itself takes different forms, according to the purpose for which it is to be used—that is, according to whether the paper speed is high or low, and the load a steady or variable one, and so forth. Again, the damping, which is provided by means of an oil bath, is adjustable, so that any required amount of dead-beatness can be obtained.

It need hardly be said that special care has been devoted to the construction of the clock, so as to provide ample working forces and to enable it to withstand the none too gentle treatment so

Fig. 3.

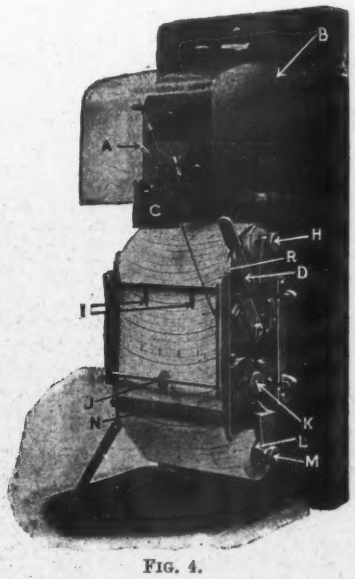


Fig. 4.

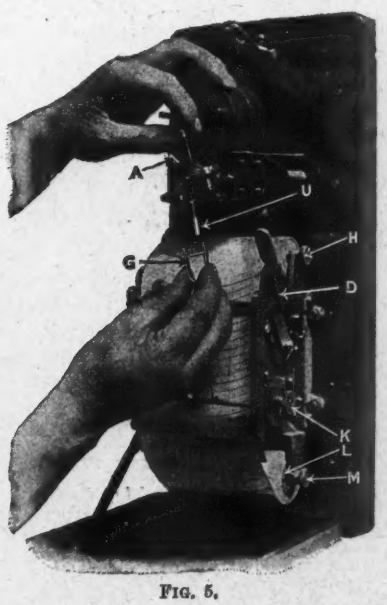


Fig. 5.

Everett, Edgcumbe "Graphic" Instruments.

often meted out to a "graphic" instrument. In this respect the long experience of Messrs. Everett, Edgcumbe & Co. in the design of such instruments has stood them in good stead.

Back-Geared Screw Limit Switch.

Amongst the many "Igranic" switch specialities of the Adams Manufacturing Co., Ltd., of Bedford, is a back-geared screw limit switch for valve control and for use with lifts or machine tools, shown in fig. 6.

It is not always convenient or desirable to install limit switches of the tappet-operated type in the well of a lift or hoist, and in such a case it is necessary to employ limit switches of the travelling-

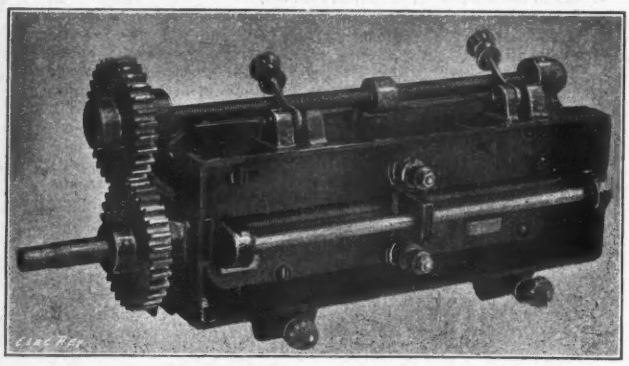


Fig. 6.—Back-Geared Screw Limit Switch.

nut or equivalent type. The Adams Igranic screw limit switches are adapted to be driven directly from a lift or valve mechanism, either by means of back gear, sprocket wheel and chain, or other positive drive.

Protecting covers, or completely enclosed or watertight cases and covers, can be provided as required.

If for use in connection with electrically-controlled motor-driven valves or slow-moving reciprocating machine tools, similar screw-actuated limit switches can be supplied, fitted with contacts opening with a snap action.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to this column should be written on one side of the paper only.*]

"Fire" writes:—We shall be glad if you or any of your readers can give us any information on the following point, for which we thank you in anticipation. Suppose a contractor estimates for the electric lighting of a house, the value of the work to be done being, say, £150, and his offer is accepted, there being no specification, or if such, there being no clause in same regarding the insurance of the work. After work to the value of, say, £50 has been completed, a fire breaks out in the house, which is completely destroyed. Is the contractor liable for the re-execution of the work which was done prior to the fire, without being paid for it? Has he any claim on the proprietor for the amount?

*** Upon the facts above stated, it appears that the contractor is clearly entitled to be paid. No mention is made of there being any necessity for a certificate of approval; but as no certificate is required, the contractor is entitled to be paid when the work is done. For what happens afterwards he is not responsible.

TRADE WITH CHINA.

The Acting Commercial Attaché at Pekin reports that the total value of machiney, railway plant and materials, electrical materials and fittings imported into China in 1910 amounted to £3,122,000. In commenting on these figures he states:—

"I desire to draw the particular attention of British manufacturers and merchants to these figures, not so much because they constitute a record import, but because they illustrate the fact that China, after some years of hesitation, has definitely entered the world's markets as a purchaser of machinery. The Chinese people have at last come to realise that railways are an indispensable factor in the development of their country's natural resources, and that the vast stores of mineral wealth that lie dormant all over the empire are of no use to them unless exploited by scientific methods. They have, moreover, awakened to the fact that with practically unlimited supplies of raw materials and cheap labour there is no reason why they should not manufacture themselves many of the articles they have hitherto imported from abroad. So railways are being constructed and projected in every province, coal and other mines are being opened and factories are springing up in all directions.

"Having called attention to the demand that exists, I would point out that owing to the increasing keenness of competition among European and American manufacturers, the tendency of the day is towards industrial and financial combines who are prepared, through their representatives stationed at Pekin, Shanghai and other important centres, to finance Chinese industrial undertakings and supply them with all the machinery and expert assistance they require. In these branches of the trade where such combination is not feasible or desirable, manufacturers are beginning to send their own agents out to China, in order to get into personal touch with the native purchasers, who belong, in a majority of cases, to the official class; or they entrust their interests to some local firm of merchants who, by means of branches in different parts of the country and through their Chinese connections, have special facilities for pushing their business. The reputation of British machinery is second to none in China, and as there is good reason to believe that our manufcturers are fully alive to the great possibilities now opening out in this part of the world, and are prepared to take a more active part than they have done hitherto in making their products known, giving, perhaps, a shade more liberal treatment to local merchants in the matter of credit and financial support, we may, I think, look forward with confidence to the United Kingdom maintaining the dominant position she now holds in the Chinese machinery market.

"The view is held by some, whose opinions are entitled to respect, that the machinery best suited to the Chinese market, at any rate for some years to come, will be of so cheap and common a description, that British manufacturers stand little chance of successful competition with Continental and Japanese makes. My experience does not altogether bear out this view. The Chinese are, I think, learning by bitter experience that to purchase cheap materials for railways, factories, &c., does not pay in the long run, and as money becomes cheaper, as it must when currency reform is firmly established, they will be in a better position than they are at present to fit out their various industrial undertakings with good and durable plant. I am informed, moreover, on good authority, that the prevailing impression regarding the costliness of British machinery is somewhat exaggerated, and that in certain branches of the trade, such as the supply of railway materials, British makers are able to tender as cheaply, if not more cheaply, than their Continental rivals. Chinese factories will be unable for some time to come to turn out any but low grade articles, which will only compete with Japanese productions of a similar class.

"Another factor which militates against the success of native industrial undertakings is their unreasonable dislike of employing foreign managers and engineers. In factories where up-to-date plant of complicated and delicate machinery has been fitted up, they dispense with the foreign expert almost as soon as the machines have started working, leaving them to the tender mercies of native engineers who are helpless as soon as anything goes wrong.

"As in the technical so in the commercial side of the undertaking, the Chinese are not yet capable of conducting large commercial enterprises, such as steamship companies, ironworks, &c., on sound business lines. The great majority of Chinese industrial companies, if not in financial difficulties, are, at any rate, earning far less than they ought, owing to inefficient management. Yet their promoters deliberately refuse to avail themselves of foreign business knowledge and experience. It should be added that the more enlightened among Chinese officials and business men are beginning to realise, in some cases as a result of bitter experience, that something more than capital, machinery and labour is necessary to make great industrial and commercial undertakings a success and are inviting foreign co-operation in the management of their companies. There is as yet no code of company laws in China, and therefore no legal obligation on so-called Chinese companies to furnish properly-audited accounts. Most of the companies now being formed to establish waterworks, electric light, telephone and tramway systems, &c., consist of groups of officials and merchants who have obtained a concession or permit from the Government. The only thing they can offer as security for a loan is a mortgage on their property, and as this involves expert valuation and investigation of titles, not to mention the necessity in the case of landed property of obtaining the Government's sanction to the mortgage, all matters requiring careful handling by an experienced man on the spot.

"It is hardly necessary to remind British manufacturers of the advantages to be derived from judicious and systematic advertising, but attention may be drawn to the facilities afforded by the rapidly increasing circulation of Chinese newspapers, copies of which are carefully scanned each morning by millions of readers all over the country, and to the growing number of foreign journals published in the Far Eastern parts in which commercial affairs are made a leading feature. The spread of railways in parts where foreign goods are still practically unknown, offers an almost unlimited field for pictorial advertisement, which would be especially appreciated in railway stations where the Chinese travelling public, as yet unaccustomed to the use of time-tables, are in the habit of assembling some hours before the departure of their train.

"The commendable practice of marking foreign goods with Chinese characters, or accompanying the package with description of contents, has now become fairly established; and in the large trade centres it is becoming the rule, especially in the case of machinery for foreign firms, to bring their goods to the notice of Chinese buyers by well-ordered displays and exhibitions of their wares."

BUSINESS NOTES.

Catalogues and Lists.—The Electrical Co., Ltd., 122-124, Charing Cross Road, London, W.C.—Eight-page finely-illustrated pamphlet briefly describing and giving prices of "Eco" electrically-wound, self-contained clocks which are made for connection to either continuous or alternating current supply, or which may be driven by their own battery. We understand that the cost of operation is about one-sixth of one unit per annum.

Messrs. Krupka & Jacoby, 11, Queen Victoria Street, London, E.C.—Illustrated price lists, also copy of a Charlottenburg test of "Graetzin" metal-filament lamps.

Messrs. Wiley & Russell Manufacturing Co., Greenfield, Mass., U.S.A.—224-page catalogue, illustrated and priced, relating to their screw plates, taps, reamers, drilling and other machines.

The Mica and Standard Insulation Co., 16 and 17, Devonshire Square, London, E.C.—Several leaflets (B. C. and D.) giving prices of standard micanite sheet insulation; round and "pure" micanite and "Landol" insulating tubes, also mica and micanite washers.

Messrs. James McMillan & Co., Clun House, Surrey Street, London, W.C.—48-page catalogue giving illustrated particulars and prices of wet and dry batteries, carbon brushes, carbon contact pieces, carbons for telegraphs and telephones—all of which are made by Messrs. Rylander & Rudolph's Fabriks Aktiebolag, Henriksdal, Sweden, for whom they are sole agents in Great Britain.

C. W. Hunt Co., New York.—Catalogue No. 11-5, describing storage battery and combined battery and trolley locomotives, crude-oil electric locomotives, &c.

The Coronation Durbar Plant at Delhi.—An Indian engineering paper contains an advertisement in which the electrical engineer-in-charge of the Royal Durbar Works, Delhi, offers for sale in January, 1912, the Coronation Durbar plant, consisting of a complete electrical power station equipment, including water-tube boilers, high-speed engines direct coupled to dynamos capable of giving an output of 1,800 KW. continuous-current at 440 volts, and 600 KW. three-phase current at 220 volts 50 cycles, with transformers and switchboards; also a very large quantity of electric fittings, materials, and lamps for interior and exterior lighting.

New Electro-Chemical Works.—It is stated that the Continentale Gesellschaft für Angewandte Elektrizitat, of Glarus, which has a share capital of £120,000, has convened an extraordinary general meeting at Basle to consider a resolution proposed by the directors with regard to the erection in England of a branch of the Poissy (Paris) works and the raising of the loan capital for the purpose.

Strike Settled.—The strike at Messrs. W. T. Glover and Co.'s cable works at Trafford Park was settled by the men returning to work on August 24th. The strike was brought about owing to the management declining to grant an immediate increase of 2s. per week all round.

Stoker Contracts.—Among stoker contracts received by the Underfeed Stoker Co., Ltd., recently for installations at electrical stations are the following:—

St. Helen's Corporation, 1 E.; Metropolitan Borough of Bermondsey, 3 E.; Hull Corporation, 4 E. and 4 Air Heaters; Hereford Corporation, 4 B. and Air Heater; Stoke-on-Trent Corporation, 3 A.; Lincoln, 1 E.; Lacroze Tramways, Buenos Aires, 4 E.; Alemana Transatlantico, Buenos Aires, 12 E.

The company has of course booked many other contracts for general installations.

Bankruptcy Proceedings.—Frederick Vickers (trading as Frederick Vickers & Co.), electrical engineer, 286, Oxford Road, Manchester, Lancaster.—The first meeting of creditors was fixed for Thursday in last week at the offices of the Official Receiver, Byron Street, Manchester, but only one creditor attended, and the matter, therefore, remains in the hands of the Official Receiver. At the Manchester Bankruptcy Court, on August 25th, the bankrupt came up for examination. He began business at 413, Oxford Road, Manchester, in November, 1908, without capital and without liabilities, after having been in business with various firms for 21 years; but one creditor had given him credit to the extent of £250. His work was general electrical installation. About 18 months ago he removed to 286, Oxford Road. Previously he had done the estimating and most of the work himself, but after the removal he took over more contracts than he could estimate for, and afterwards the estimates given by his foreman proved to have been too low, and he lost a considerable amount of money on those contracts. He also incurred business expenses heavier than the increase in cash sales warranted. He estimated his unsecured liabilities at £455 and his assets at £58. The Registrar (Mr. Atkinson) closed the examination.

W. H. Ridpath (Ridpath & Wells), electrical engineer, Ilkeston.—September 9th last day for receipt of proofs for intended dividend by the trustee, Mr. E. W. Humphreys, 5, Victoria Buildings, London Road, Derby.

Dissolutions and Liquidations.—Havana Telephone Securities Co., Ltd.—This company is winding up voluntarily with Mr. George Banks, New Broad Street House, E.C., as liquidator.

The Starlight Electric Co., 38, Alexandra Street, Southend-on-Sea.—Messrs. A. A. Kerridge and H. Sloman have dissolved partnership. Mr. A. A. Kerridge will attend to debts and continue the business.

Book Notices.—*Calendar* of the Glasgow and West of Scotland Technical College, 1911-1912. Glasgow: The College.

"Il Nuovo Cimento." August 18th, 1911. Pisa: Tipo. Toscano.

"Technical Papers, Nos. 3 and 4," and "Miners' Circular, 4." 1911. Washington: Government Printing Office.

"Boletin de la Sociedad de Fomento Fabril." July 1st, 1911. Santiago de Chile: The Society.

"Revue d'Electricité." Vol. XXVIII, No. 7. July, 1911. Brussels: Société Belge d'Electriciens. Price 1 fr. 75.

"The Physical Review." Vol. XXXIII, No. 1. July, 1911. Lancaster, Pa.: The "Review" Offices. Price 65 c.

Trade Announcements.—The Standard Cable Manufacturing Co., Ltd., of Queenhithe, E.C., advise us that they have opened a contract office at 198A, St. Vincent Street, Glasgow, from which they can submit estimates for the complete installation of all descriptions of electric cables in towns, mills, docks, collieries, exhibitions, &c.

The business of Messrs. Hall & Mathews, electrical engineers, of Ecclesall Road and West Street, Sheffield, has been transferred to Messrs. Renton, Holdsworth & Co., Ltd., of Norfolk Street, Sheffield.

Mr. Joyce, electrical engineer, has opened business premises at Oxted (Surrey).

The British Thomson-Houston Co.'s Manchester office, at present at 30, Cross Street, is being removed on September 7th to National Buildings, St. Mary's Parsonage. Their new telephone number will be 6366 Central (three lines). The new premises include commodious stores, and a large stock will be carried of "Mazda" metal-filament lamps, B.T.-H.-Edison carbon lamps, holophane glassware, &c.

LIGHTING and POWER NOTES.

Abercarn.—With a view to improving the lighting in the neighbourhood of the Crumlin Navigation Colliery, the U.D.C. has decided to co-operate with the colliery company in the matter of introducing electricity for illuminating the streets.

Aldeburgh.—The T.C. on Friday decided to lease land for the erection of a generating station to the Electric Supply Co., Ltd., who are to supply energy for public lighting.

Arnside.—There is a probability of the public lighting at Arnside being converted from oil to electricity. Mr. Thos. Wilkinson, a local resident, has installed a complete plant at his residence, and utilises electricity for lighting, cooking and laundry work, and he has arranged to wire and supply Earnseat Schools, for Mr. J. W. Bland. It is hoped that the authorities will supersede the present oil lamps for public lighting with electric lamps.

Australia.—The Electric Lighting Committee of the Sydney (N.S.W.) Council agreed on July 25th to recommend the expenditure of large sums of money for the extension of the electric supply to various portions of the city and suburbs. It was explained that arrangements for the supply of Alexandria must be completed before the end of the year, the estimated cost being £5,235. In this connection it was agreed to purchase a site for a sub-station at a cost of £100, and to erect the sub-station at an additional outlay of £375. A temporary structure is to be erected at Botany, whilst a sum of £1,800 is to be expended in the erection of poles and cables to Botany. The erection of poles and cables to Erskineville will absorb another £3,700, materials for further extensions approximating £800. The electrical engineer was instructed to obtain options for sub-station sites in the various municipalities. Work is proceeding rapidly with the mains reticulation of Darling Point and Woollahra, the service being partly overhead and partly underground. With the Balmains Electric Supply Corporation and the Sydney Municipal Council both competing for supply in the various suburban municipalities, the local authorities are enabled to make fairly good bargains with their street lighting. The Sydney Municipal Council has just arranged to take over the lighting of the municipality of Redfern, which has had its own plant for some years.

Bangor.—A L.G.B. inquiry was held on August 24th relative to the application of the T.C. for a loan of £2,000 for the provision of additional plant at the E.L. works. There was no opposition.

Chipping Norton.—The T.C. has accepted the tender of Mr. W. A. Schultz for public lighting by electricity from August 14th to May 14th, at £150.

Barnsley.—An inquiry has been held by the L.G.B. in reference to the application of the Corporation for sanction to borrow £16,100 for purposes of electricity extensions in the borough. The details of the scheme, as supplied by Mr. Barker, the borough electrical engineer, are as follows:—500-KW. turbo-generator complete with condensing plant, £3,500; excavating, foundations, &c., £370; cooling tower (as per accepted tender), £795; excavating and foundations for same, £650; water-tube boiler (as per accepted tender), £1,200; brickwork and extension to main flue, £280; borewell (as per accepted tender), £650; extensions to switchboard, £200; cables and connections, £210; water meter, £75; steam,

water, and circulating pipes and valves, £250; extension buildings (one bay), £500; contingencies, £35; making a total of £8,715, less an outstanding loan on existing tower to be superseded and met out of revenue, £415, reducing the amount to £8,300; prospective mains and services, £6,700; new lamp columns and fittings, £1,100, bringing the amount asked for to £16,100.—Mr. Barker referred to the increase in the use of electricity within the borough, and anticipated developments, and mentioned that the Committee proposed to substitute electric lighting for 500 remaining street gas lamps.—No opposition was raised to the scheme.

Continental Notes.—Austria.—The city of Innsbruck intends to acquire Lake Achen, with a view to setting up a new electric light and power station. The purchase price amounts to about 4,000,000 k. In view of this new scheme, the project to obtain 75,000 H.P. from the Gerloch and Ziller becks will be left over for private industrial users. Messrs. Dykerhoff, of Nürnberg, who have the whole scheme in hand, will be open to arrange contracts with parties interested up to the end of the year.

Dukinfield-Mossley.—The Stalybridge, Hyde, Mossley and Dukinfield Tramways and Electricity Board has applied to the B. of T. for consent to the placing of transmission wires above ground along various routes in Dukinfield and Mossley for the purposes of supply under the Act of 1901.

Halesowen.—The Halesowen and Stourbridge Hospital Committee has decided to light the Hospital at Hayley Green by electricity. The Committee proposes to install its own plant.

Hastings.—The B. of G. has received an order from the L.G.B. sanctioning the installation of the E.L. at the workhouse.

Hebden Bridge.—The U.D.C. has under consideration an application from Messrs. Pickles & Sons, machinists, for an estimated supply of 20,000 units per annum and a maximum of 40,000 units. It is proposed to enter into a five years' agreement, and a new scale of discounts has been adopted in view of this and similar cases, varying from 15 per cent. for 2,000-2,600 units per quarter to 37½ per cent. for over 5,000 units per quarter.

Heckmondwike.—The U.D.C. has resolved that a strongly-worded request be sent to the L.G.B. for an answer to the Council's application for sanction to borrow money for the erection of new condensing plant at the electricity works. It was stated at the meeting that other councils whose inquiries were held later than that of Heckmondwike had already received sanction, and that the delay was causing the town to lose money week by week.

India.—According to the *Times of India*, the directors of the Tata Hydro-electric Power Co., Bombay, have received and considered applications for the supply of power from 24 mills, aggregating about 27,000 H.P.

The municipal authorities of Chittagong have granted a licence to the agents of the A. E. G. Lahmeyer Co. for the supply of electrical energy for lighting and power purposes in the town.

Llandudno.—On the Electricity Committee's recommendation, application is being made to the L.G.B. for sanction to borrow a further sum of £500 to cover the estimated cost of laying additional mains during the next two years.

Llangollen.—The U.D.C. has appointed a Committee to go into the E.L. question, over which a difficulty has arisen. The Council is legally informed that its action in obtaining a prov. order, and then transferring the powers to the E.L. company, who repaid £200 spent in obtaining the order, is illegal, and is advised to acquire the undertaking from the company and supply the town, or to apply for an amending order enabling the Council to legally transfer the prov. order obtained to the company, who at present are not the legally appointed agents of the Council.

Moseley.—Preparations are being made by the electric supply department of the Birmingham T.C. to extend the mains to Moseley, and current will be available before the coming winter.

New Malden.—The L.G.B. has forwarded its sanction for the supply of current in the urban district by the Wimbledon T.C., and the laying of mains will be proceeded with forthwith.

Pittington (Co. Durham).—The local Co-operative Society has installed an E.L. plant, at a cost of £500. The work has been carried out by Messrs. T. G. Usher & Co., of Newcastle-on-Tyne.

Pontardawe.—Messrs. Gilbertson & Co., who have been given permission to erect poles and overhead lines for the conveyance of current, have asked the U.D.C. whether it will take over some portion of the installation if the Council at any time obtains powers to supply current throughout the district, as without some such understanding they would hesitate to go to the expense, which would amount to from £300 to £500. The Council, on August 24th, referred the matter to a committee.

Rawtenstall.—A L.G.B. inquiry was held on August 23rd relative to the application of the T.C. for a loan of £2,000 for public lighting by electricity. The distance to be covered is 13 miles, and the lamps number about 500. By substituting electricity the Council anticipates a yearly saving of £322 10s. Gas is charged for at 8s. per 1,000 cub. ft., less 3½ per cent. There was no opposition.

Rugby.—The U.D.C. has obtained an important consumer of current in Rugby School, which has hitherto had its own installation. This has now been shut down, and the whole of the school and boarding-house premises have been connected with the town supply, while the entire wiring installation has been overhauled.

Sidmouth.—The Sidmouth Gas and Electricity Bill, promoted by the Sidmouth Gas Co., has now received the Royal assent, and the company now possesses powers to supply electricity. It is stated, however, that nothing will be done for 12 months or so, pending the deliberations of the District Council, and the decision of that body whether or not it shall acquire and carry on the business of supplying Sidmouth with gas and electricity.

Stockton Heath (near Runcorn).—The Parochial Committee has decided to ask the Runcorn R.D.C. to keep the requirements of Stockton Heath in view when powers to supply current in the district are granted to the Mersey Power Co.

Stockton-on-Tees.—During the 12 months ended March 31st last, 1,018,372 units were generated and 920,256 units sold for lighting and power by the Corporation Electricity Department. The maximum load on the feeders was 644 KW. The capacity of the plant at present installed at Stockton is 1,050 K.W., which allows 400 KW. as spare in case of breakdown. As the load on the station is continually increasing, a decision was recently arrived at to increase the generating plant to deal with next winter's load, and to install a 400-KW. mixed pressure D.C. turbo-generator, together with the necessary switchgear. The cooling tower is to be extended so as to increase the efficiency of the present turbine, and the existing boilers are to be fitted with superheaters. The contract for a mixed pressure turbine, combined with a Siemens D.C. 400 to 500-KW. generator, has been let to Messrs. Richardsons, Westgarth & Co. The switchgear will be supplied by Messrs. Drake and Gorham, a cooling tower by the Klein Engineering Co., and a feed water meter and superheaters by Messrs. T. Sugden. When the extensions enumerated above have been brought into use, it is estimated that there will be a saving in fuel consumption of about 20 per cent.

Stoke-upon-Trent.—The L.G.B. has sanctioned the borrowing by the R.D.C. of £300 for the public lighting of Bucknall and a portion of Eaves Lane. The loan is repayable in ten years.

TRAMWAY and RAILWAY NOTES.

Accrington.—Another stage in the tramways assessment dispute between Accrington Corporation and Haslingden Union was reached during last week. At a meeting of Haslingden Assessment Committee, on August 23rd, it was agreed to join Accrington in a request to the umpire to submit the detailed valuation showing how the gross estimated rental and rateable value were arrived at. After the electrification of the Accrington tramways, the Haslingden Union valuer provisionally fixed the rateable value of the undertaking within the Accrington borough boundry at £1,650. As this was a considerable increase on the old figures, the Corporation proposed to appeal to Quarter Sessions. Following an exchange of views, it was agreed to accept £825 as the amount of the rateable value, or exactly half the sum. The Corporation thought that £650 should be the limit, and this led to arbitration proceedings. Mr. Wainwright, of Liverpool, officiated in this capacity, and his award has led to the present agitation.

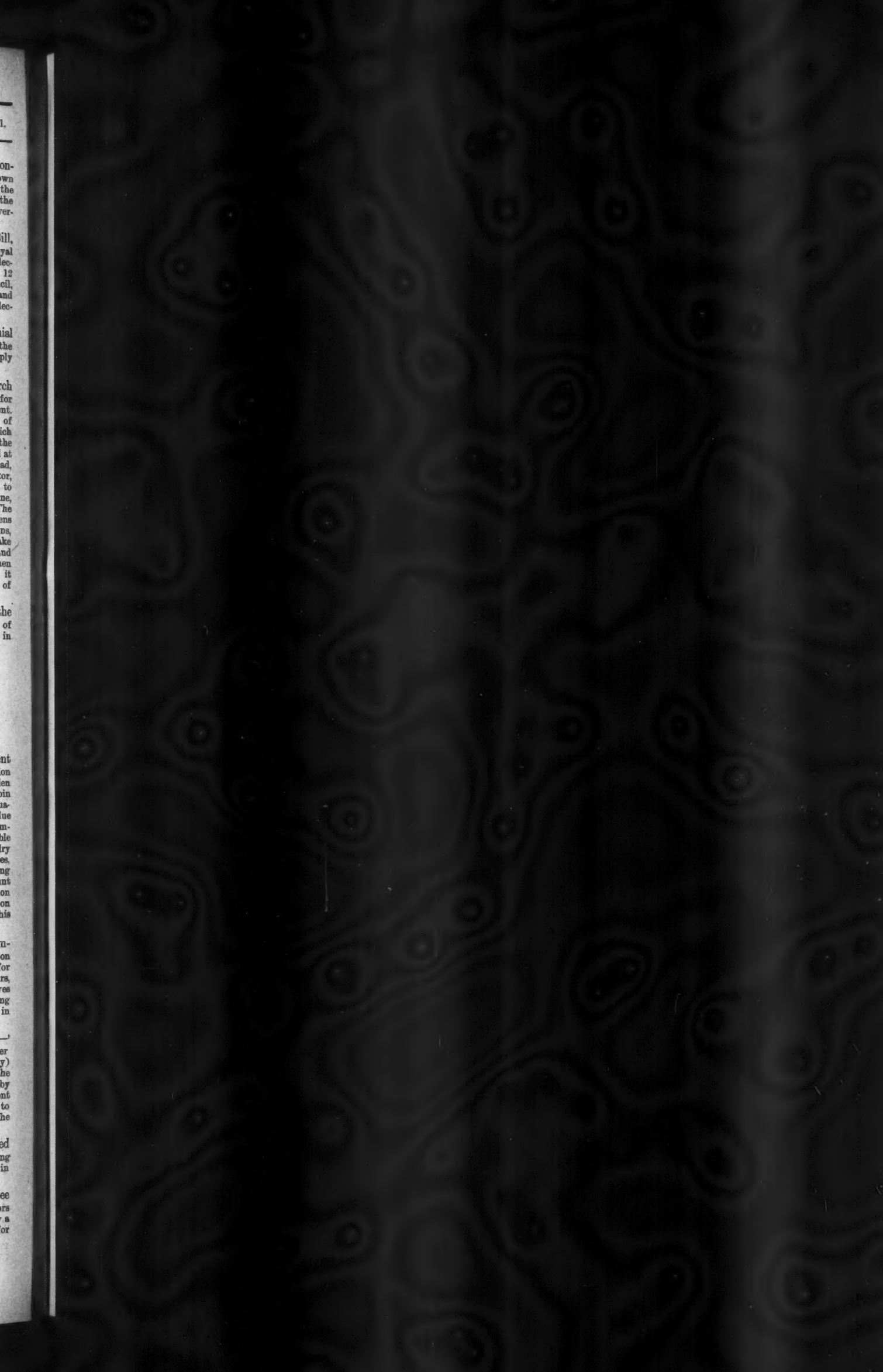
Ashton.—The employés of the Stalybridge Joint Tramways Board, Ashton Corporation Tramways, and the Oldham, Ashton and Hyde Tramways Co. have sent in claims to the authorities for improved conditions of labour. Their grievances relate to hours, meal times and wages. Following a meeting of the representatives of the joint authorities, the Ashton Tramways Committee is calling a special meeting for the consideration of the various questions in dispute.

Australia.—Victorian Railway Electrification.—In responding to a toast at the Commercial Travellers' Club dinner the Acting Premier said that the Premier (the Hon. J. Murray) had been making inquiries in England on the question of the electrification of the railways. Information had come to hand by letter and by cable message from the Premier that the Government would have a policy to announce within two months in respect to the conversion almost immediately to electrical working of the suburban railway service.

Milnrow.—The Rochdale Corporation has commenced the long-expected extension of the tramway system to the adjoining township of Milnrow, this week. Preliminary work has been in progress some time.

Wigan.—On August 22nd the Tramways Committee passed a resolution that the wages of the motormen, conductors and shedmen connected with the local tramways, be increased by a farthing per hour. The men had been agitating some time for increased remuneration.

(*Continued on page* 343.)



THE METAL-FILAMENT LAMP FACTORY OF PHILIPS & SON, EINDHOVEN.

When it is taken into consideration how recently the metal-filament lamp has come into use, it says much for the enterprise of manufacturers, that they have at once taken steps to meet the universal demand which has arisen, and in doing so have not hesitated to expend thought and money in putting up adequate factories, machinery and laboratories, and in training and looking after the welfare of the large number of employés engaged.

One of the most important lamp factories is that of Messrs. Philips & Son, Eindhoven, Holland, which we had the pleasure of inspecting, under the guidance of Mr. Antony Philips, who, with his brother, has been responsible for the erection of a works exclusively devoted to the manufacture of lamps, which is the largest in Holland, and the second largest in Europe. Over 3,000 hands are employed, a number which is almost incredible, when it is remembered that in 1891 there were only 30 hands employed in the original factory established for the manufacture of carbon lamps; everything pertaining to the lamp is manufactured on the spot, with the exception of the metal caps and the bulbs.

Some idea of the rapid growth of the works may be gathered from the following figures:—In 1891, 30 workers were employed, 600 in 1903, 1,200 in 1909, 2,000 in 1910, and in 1911, 3,250, at the date of our visit. The greatest increases, as will be noted, have occurred since the metal-filament lamp factory was started.

Of the 3,250 hands, 300 are employed in a machine shop of large dimensions, fitted with machine tools of the latest pattern, which is exclusively occupied in the making and maintenance of the plant employed in the factory: we were assured that this machine shop is self-supporting, besides possessing advantages in the matter of secrecy and promptitude of delivery of machines specially required.

new buildings, one of which is reserved exclusively for offices and administration, and includes an estate agency, architect's drawing offices and building department in connection with the village, to which we shall refer later. The most noteworthy feature in this building is the spaciousness of the rooms and the amount of light in every part, while

The Philips Metal Lamp Works, East Side, 1910.

heating and ventilation are provided on a scale, and with a thoroughness that is seldom seen in the offices of manufacturing concerns.

The main factory building, six storeys high, is impressive from its size alone, and here, too, lighting, ventilation and heating have been thoroughly considered.

The Philips Lamp Works: Grading the Filaments.

The works power station is capable of an output of 850 H.P., and on the occasion of our visit the boilers were being erected to supply steam to a further 400-H.P. Belliss engine, which will be delivered immediately.

The principal interest, however, lies in the two enormous

On the sixth floor accommodation is provided for the technical staff, and spacious laboratories were being fitted up and furnished to take the place of the old laboratory, which itself was of no mean description. Here a highly-trained technical staff is constantly engaged in research work, and it

is largely due to this department that the lamp as now manufactured possesses such a strong filament. On this same floor the filaments are flashed in hydrogen.

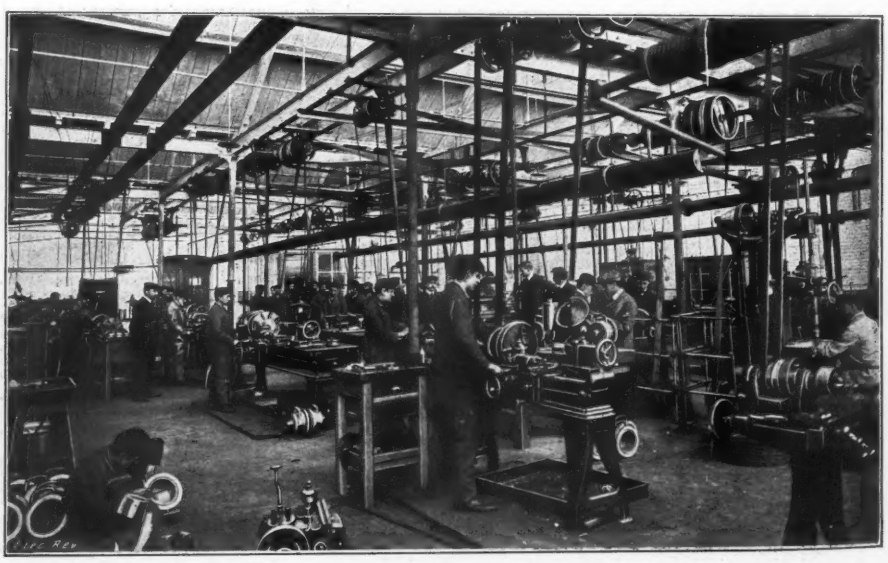
Proceeding to the fifth floor, we were shown the processes of baking and drawing the filaments, the preparation of the mixture, and the manufacture of the dies, including the boring of the diamonds. On the fourth floor, the squirting of the filaments through the dies, and the measuring and

The Philips Works, West Side, 1911.

classification of the filaments was shown, this being the only process in which it is necessary to send the filaments upstairs again, the work beginning at the top of the building and gradually passing down to the basement, with this exception, rendered necessary on account of the flashing process having to take place on the top floor.

Our attention was particularly called to the increasing tenacity and elasticity of the filament as it approached completion, the filament before enclosure in the bulb being like fine steel wire, capable of bending into a loop without breaking.

Thus far we have dealt with the manufacture of the filament; and it is now necessary to turn briefly to the process of glass-blowing. Bench after bench is occupied by girls or boys with nimble fingers carrying out one or other operation, with the assistance of ingenious time-saving machinery. A glass tube, cut off to a precise length, is put into a machine and submitted to an oxy-hydrogen flame; a few deft touches and the upper part of a bulb is evolved; this goes to another bench, where leading-in wires are inserted, and a pair of jaws rise up and pinch the glowing glass to the shape so well known. Further on boys insert the supporting hooks in glass rods. These are welded into place, the filaments are fitted, the whole enclosed in the bulb, which has just been provided with an exhausting tube, and then passes to the exhaust pumps, preparatory to a visit to the test room to be classified for voltage, wattage and candle-power. From the test room lamps go at the rate of 25,000 per day to the packing rooms, where they are dispatched to every quarter of the world.



The Works Machine-Shop.

Throughout these six floors there are extractors to remove foul air and gases, while a powerful fan injects fresh air passed through a filter and through cooling coils in summer and heating coils in winter.

The well-being of the worker has received special attention; spacious lavatories are provided on every floor with abundant accommodation, so that cleanliness is a distinguishing feature.

On the third floor there is a surgery and operating room, with nurses constantly, and a doctor at specified hours, in attendance. There, accidents are treated and illness prescribed for, showing an important saving to the firm in time, which would otherwise be lost, by an employé going to a hospital or local doctor, with the further gain that a trivial accident, properly treated, only causes a worker to lose a few minutes and the wound heals quickly, whereas delay may, and has rendered even trivial hurts serious.

As Eindhoven itself does not provide sufficient labour, workers to the number of 800 come in by special trains from the outlying districts, and for their accommodation a restaurant is provided, where coffee is supplied free, the girls bringing their own food; it is intended, if practicable, to provide a hot meal in winter at a nominal charge.

Mention has been made of the village. To provide accommodation for the workmen within easy distance of the factory, Messrs. Philips purchased several large tracts of ground, and have transformed them into quite a model village called Philips Dorp, where a house with garden can be rented at from 4s. to 6s. per week. The houses at 6s. have about 60 ft. of garden, are well built and decorated, and have five or six rooms with outhouse and all conveniences. These are intended for employés earning about £2 per week, while the cheaper houses are intended for workers with families. We saw one family of eight, most of whom will in time be drafted into the works, and like the boys who fix the wire supports, be gradually advanced to more responsible work.

The Philips lamp is so well known under various names in this country that comment on our part is quite unnecessary.

We were shown certificates from the various testing authorities, which indicated a steady improvement in

life and candle-power, and a reduction in current cost; we understand that it was a Philips lamp under the name "Metalik," which came out on top in the Westminster tests.

The following is a translation of a letter from the municipal power station in Utrecht, dated September 15th, 1910, Nic. Beetsstr. 3 :—

In connection with our letter dated July 29th of this year, J No. II, 1,664, we beg to inform you that the test made up to the present with the metal-filament lamps sent us has given the following results :—

1 lamp	...	...	806 hours	1 lamp	...	...	3,136 hours
1 „	...	...	838 „	1 „	...	...	2,064 „
1 „	...	...	1,000 „	1 „	...	...	3,136 „
1 „	...	...	2,915 „	1 „	...	...	3,304 „
1 „	...	...	3,136 „	1 „	...	...	3,496 „
1 „	...	...	3,472 „	1 „	...	...	1,693 „
1 „	...	...	2,800 „	1 „	...	...	2,443 „

The lamp burning 3,496 hours continued to burn after the test was finished. We have made a photometric observation of this 32-C.P. lamp and have ascertained that its strength of light was still about 28 C.P., and that the consumption in energy was about 1·16 watt per C.P.

The average length of burning of each of the lamps sent amounted to 2,445 hours.

The dominant ideas throughout the whole place are economy and efficiency, but these ideas have been so intelligently carried out, that economy has not meant stinginess, and apparent extravagance has been amply justified by increased efficiency and ultimate lower costs of manufacture.

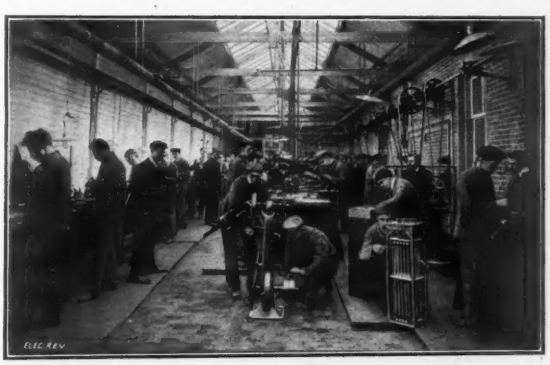
In conclusion, our thanks are due to Mr. Antony and Mr. Gerald Philips for their courtesy and kindness, and for the opportunity of witnessing the complete process of manufacture, and having it explained in a most interesting manner.

AN ELECTRICALLY-DRIVEN SHIP.

The last few years have seen many attempts to upset the orthodox methods of the marine engineer in regard to ship propulsion. The turbine, by itself or in conjunction with the reciprocating engine, has firmly established itself in certain directions, while the geared turbine appears to be a future competitor.

Internal-combustion engines, so popular in small craft, are getting a footing in the merchant service, where the Diesel oil engine is on its trial, and even the gas engine is being experimented with.

Perhaps the most radical change which the long-suffering "chief" may expect to find in a ship is the introduction of an electrical transmission between engine and propeller, such as has been tried by Messrs. Mavor & Coulson, Ltd., on the *Electric Arc*, a 50-ft. passenger boat, of 12 ft. beam, built by Messrs. Maclaren Bros., of Dumbarton.



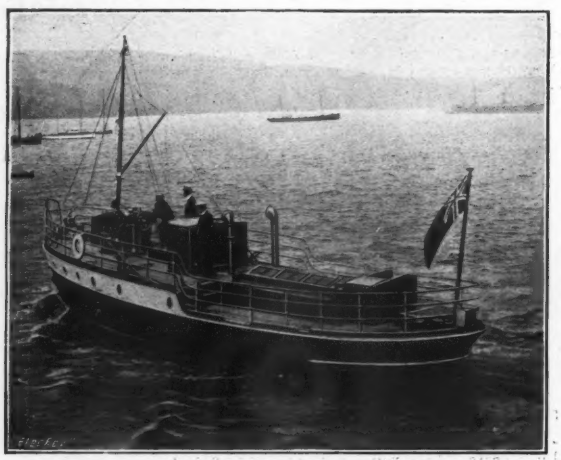
The Works Fitting Shop; Philips Lamp Works.

A demonstration of this ship took place on the Gareloch about two months ago, when a mean speed of 7¼ knots was obtained over the measured mile. The electrical part of the equipment consists of a generator capable of furnishing two alternating currents of different periodicities, and of a motor coupled direct to the propeller, and having two independent windings, the number of poles being so chosen that two different speeds may be obtained on the boat by suitably connecting the two motor windings to the supply of the appropriate periodicity. During the run the volts and amperes in one circuit were 380 and 10·5 respectively, and in the second circuit 410 and 25·5. The propeller revolutions were 415 per minute. Taking into account the power factor of the motor, these figures indicated about 25 B.H.P. delivered to the propeller shaft in order to obtain the speed of 7¼ knots. The boat was taken to the head of the loch, where a demonstration was given of the ease with which it could be manœuvred. Two switches only are in use for controlling the propelling machinery, and both these switches are controlled from the bridge by means of an ordinary Chadburn telegraph instrument. This is arranged

The Philips Lamp Works, showing the Flashing Benches.

so that, instead of merely signalling to the engine room, it actually throws over into the proper positions, the two switches which make the necessary alterations in the electrical connections. The order of operations is as follows:—

1. The exciter circuit is broken by throwing over one handle of the telegraph instrument from the "on" to the



The "Electric Arc."

"off" position, the electrical circuits being thus made dead, the other handle of the telegraph instrument is put in any desired position—"full ahead," "full astern," or "half ahead," "half astern."

2. The excitation is restored by bringing back the first handle from the "off" to the "on" position. The alternator then gradually comes up, and currents are established in the proper circuits. The actual throwing over of the switches can be done as quickly as the operator wishes, and the handles are interlocked, so that it is impossible to move the main switch except when the exciter switch is at the "off" position, thus ensuring that no currents can be broken on the main switches. By means of this apparatus the boat was repeatedly reversed from "ahead" to "astern," or *vice versa*, and carried out all the evolutions required in a most satisfactory manner. It was also demonstrated that the switch handle could be thrown over from "full ahead" to "full astern" without any danger of injury to any part of the apparatus. This would not be necessary in practice,

Interior of Engine Room, looking forward.

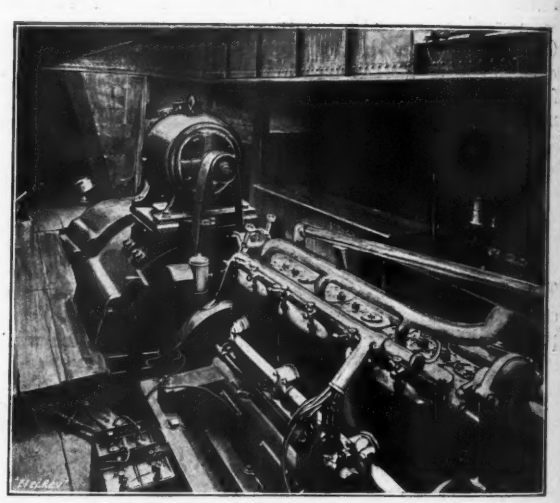
as no time is saved by omitting the "half ahead" and "half astern" positions. It is, nevertheless, a good test of the electrical parts of the machinery, as it shows the largest possible currents which can be put through any of the windings of the machines or through any of the leads and connections.

Needless to add, the *Electric Arc* has been built for demonstration purposes, with the idea of providing a suitable and flexible electrical coupling between the prime mover and propeller, each of which, under these conditions, can be built and operated with a view to obtaining its maximum efficiency.

PERSONAL PUBLICITY.

[communicated.]

For two reasons it has recently become more than ever necessary for supply authorities to turn their minds to the increase of the output of electrical energy for domestic purposes. The first, and simplest of these, is that the wire lamp has decreased the consumption of those consumers already on the mains, and has also placed electricity in a more advantageous position to compete with gas lighting from the point of view of cost. The second reason is that all those to whom electricity is of such obvious advantage that it required no exertion to induce them to become consumers, have been connected, while the electrical manufacturer provides a large and efficient body of men to seek out the power user, and to induce him to install an electrical system in place of whatever obsolete method he may be employing. Hence it has become necessary to tap lower and lower strata of revenue-earning material, and in



Interior of Engine Room, "Electric Arc."

most districts there is a—more or less—Publicity Department, which, by the distribution of "popular" literature, and by house-to-house canvassing, endeavours to attract the eye of the householder to the advantage of a safe system of "clean, cool cookery" and lighting.

Unfortunately, the supply authorities did not at first recognise the importance of this department, and desired to run it inexpensively; consequently, the majority of men engaged in this work were technically uneducated. When at last the value of the department was made manifest, efforts were made to secure technical men, and some such have recently entered the field. They have not yet, however, overcome the influence of their predecessors, and have even to some extent adopted their methods. It is rightly assumed that the best way to induce the householder to use electricity is to educate him, and with this intention many pamphlets have been issued explaining electrical matters in popular language. The popular language adopted is, unfortunately, that of the earlier workers in these departments, and so the impression arises that because the subject has to be treated elementarily, it must also be treated in a style in which no educated man would write on ordinary subjects. It seems to be on the principle on which elderly people address small children—in language more infantile than that used by the children themselves.

Whatever the cause, it is undeniable that whenever one

picks up one of these treatises, there is some glaring offence against literary style which turns the attention of the reader away from the subject, the study of which is not generally resumed on that occasion. Undoubtedly, these works are effective in some quarters, or they would not be reproduced; but there is a large class of possible consumers who are otherwise cultured, but who are ignorant on technical matters. Such a class is rarely touched, except by the personal efforts of engineers among their friends, and this method is bound to be slow in producing large results, and cannot possibly be sufficiently extensive in its action. Perhaps the time may come when some work will be produced on electrical matters which, although elementary, cannot justly be termed a "work of vulgarisation" in every sense of the term.

It is fortunate that men in these departments realise the necessity of some special knowledge, in addition to the usual qualifications of an engineer. As an example, mention might be made of one highly-placed central station engineer who proposes to take lessons in cookery. It is proposed also to employ ladies for this work, as they would be more on equal terms with the consumer, and this idea has many points in its favour. But recently, the opinion of a lady was asked on this subject, and she stated most emphatically that she infinitely preferred a man to deal with; and she further stated that she did not want any lady canvassers coming round to teach her cookery. What she did require was a man to tell her how long, and how much electricity, it took to boil a given quantity of water, and to explain the method of adjusting the heating. Given that information, her own knowledge of cookery would be sufficient to devise methods of employing the advantages of the system. A lady canvasser would be sure to have her own ideas on domestic matters, which might clash with those of the consumer's wife.

Similarly with regard to lighting, it was suggested some time ago that a lady would be more effective, as she would be able to point out the advantage of "pink shaded lights on the piano," and generally, by the exercise of her own knowledge and taste, to assist in the arrangement of the installation, so rendering a valuable service both to consumer and supplier. However, there are dangers in this. The whole matter is one of taste, and though we know the Latin proverb, we also know that nothing is more fatal than to disagree with another on a matter of taste. In such a case as the above, the whole of the negotiations might be broken off at once, and all the advice would be tainted by one piece of what is, in the eyes of the possible consumer, "bad taste." It is far better for one to go who will avoid the decision of matters of this kind, but who will at the same time be able to appreciate the taste of the consumer, and bring forward whatever will be acceptable; and this can only be done impartially by one who does not personally take the responsibility of such decisions in other cases.—R. S. T. V.

TRAMWAY and RAILWAY NOTES.

(*Continued from page* 338.)

Blackpool.—The Tramways Committee spent considerable time on August 24th hearing the reply of the general manager, Mr. C. Furness, to the grievances set forth by the motormen and conductors respecting their hours of duty. After an exhaustive investigation, the Committee instructed the town clerk to reply "That the Committee cannot see their way to accept the suggested schedule submitted by Mr. J. R. Clynes, M.P., which, on the advice of the general manager, is considered unworkable." Mr. Furness said the Union were suggesting hours which medical experts of the Amalgamated Association of Tramway and Vehicle Workers were endeavouring to stop as being injurious to health. The tramway day had only a spread-over of 16 hours, therefore a double shift of men in lieu of present split-shift system, which was commonly in vogue in 60 municipal tramway undertakings, would only give a week of 48 hours. He felt sure the majority of traffic employés would not consider "double shift" a satisfactory alternative if any wage reduction resulted from the change. In every seven weeks the motormen and conductors' duties rotated completely round, thus giving each employé one rest day per week. Under the present "split shift" system, 56 men were required to work 16 service cars in the winter. Under the "double shift" system suggested by Mr. Clynes' Union, 70 men would be required, equivalent to an increase of 25 per cent. in wages. The bulk of the men affected by the proposed alteration had not been consulted or considered, and they would not agree to the conditions the proposed rearrangement of hours would entail. Double shifts were chiefly in operation in cities and large industrial centres where the tramway day extended over 18 hours, thus making it easy for nine-hour shifts to be satisfactorily worked. It was quite feasible to introduce a double shift in Blackpool during the winter months, but it would have to be on a 48 hours weekly basis, and the majority of the men would not be prepared to accept same with a corresponding reduction in wages. The present rates and hours of labour compared most favourably with other towns, and Mr. Furness could not recommend any alteration of the split shift system. In nine towns men worked over 60 hours per week, 52 towns worked 60 hours per week, 10 worked from 55½ to 58½ hours per week, and 14 under 54 hours per week.

Burry Port and Gwendreath.—The Light Railway Commissioners have granted an order authorising the reconstruction and working as a light railway of a further portion of the lines of the Burry Port and Gwendreath Valley Railway Co.

Continental Notes.—Spain.—A concession has recently been granted by the Spanish Ministry of Public Works for the construction and working of an electric tramway between Porriro and Vigo.

France.—Steady progress is being made with the electrification of the Pyrenean network of the Chemin de Fer du Midi. The first portion of its programme comprises 12 sections of an aggregate extent of 532 km., 52 km. of which is a metre gauge line from Castelnau to Tarbes. At the beginning current will be supplied by three generating stations, two of them being situated respectively at Pierrefitte-Nectatas and Eaux Chandes, on Lake Sousoneou. It is intended to use single-phase current at 15 cycles, delivered at a pressure of 55,000 volts. Stepped down to 10,000 volts at the transformer sub-stations, it will be distributed by trolleys over the working lines to the trains themselves at 285 volts. The locomotives will be of two kinds—the 4-motor single-phase type of 125 H.P. each, weighing about 56 tons, to carry 50 passengers and their baggage will work the express and heavy goods service. The stations will utilise, when they come into working, the waters of several of the beautiful lakes and pools in the Pyrenees. The dam across the natural basin at Bouillouses has already been constructed 15 metres high, and the Cassagur station already draws its power from this reservoir to feed the Villefranche-Bourg Madane line. The station equipment is of 5,000 H.P., and supplies current at 800 volts in the immediate district.

Greece.—A general strike of the employés of the Athens and Piræus tramways extended over two days last week. The strike was due to the resignation of the manager, who the men demanded should remain at his post. The Government intervened to require, in conformity with agreement, that the headquarters of the company, which are at present in Brussels, should be transferred to Athens.

Halifax.—In order to bring about a better timing of the cars, the Tramways Committee has decided to have a master clock erected in Commercial Street. Every morning at 10 o'clock it will be set according to Greenwich time, and will control the working of the clocks at the Cow Green, Union Street, and Waterhouse Street termini.

Liverpool.—As the outcome of the intervention of the B. of T., the Corporation Tramways Committee eventually agreed to reinstate, on certain specified conditions, the drivers and conductors who left their work during the recent strike. The decision raised a protest from the local Shipowners' Association, which had locked out its own men.

London.—In connection with our note last week respecting the effect of the recent railway strike on the London electrically-worked railways, the Brighton Railway authorities inform us that, contrary to our information last week, their South London and Crystal Palace lines were working quite as usual (one or two stations only being closed). The company, in fact, rather prided itself on the above circumstance, and we can only add our congratulations.

A special meeting of the Highways Committee of the L.C.C. met, on Friday last week, a deputation of the tramway men, when it was agreed that certain matters should be settled the next day by the manager, and that a Conciliation Board should meet on or before October 9th, if desired by the men.

New Zealand.—According to the *Times*, the Government has made its first move towards exercising the unlimited powers of regulation of tramways that it recently obtained by the passing of an amending Tramway Act. The new law enables the Minister of Public Works to impose regulations, even to the extent of overriding authorising orders, without reference to any one; but the first batch proposed have been referred to the municipal tramway authorities for their suggestions. Included are stringent provisions as to overcrowding, carrying passengers beyond the seating capacity of cars, and many traffic details, while car construction must be brought into conformity with the provisions now laid down. Very small scope is left to authorities in their future choice of plant, almost every item being placed on a compulsory list. One regulation stipulates that the gap on the car lightning arresters shall be $\frac{1}{12}$ in., and minute directions for valves, details of sanding gear, &c., are laid down. The publication of these regulations has roused a storm of protest, ridicule, and even defiance. The engineer of the Wellington tramways has advised

his Council that it will cost that system £75,000 to comply with the regulations, that the additional annual cost will amount to £40,000, and that fares will have to be increased about 50 per cent. to meet the outlay.

Southend-on-Sea.—The Light Railway Commissioners have granted an order authorising the extension of the tramways in the town by the T.C.

TELEGRAPH and TELEPHONE NOTES.

Madeira Telephones.—A correspondent writing from Funchal, Madeira, under date August 18th, says:—"Allow me to correct a slight error in your issue of August 11th in the paragraph under Madeira, referring to the proposed telephone service. The project for the installation of a telephone service in Madeira is far from being abandoned, for the installation is now nearly completed. The lines have been run, and the instruments are now being erected, and within a few weeks the service will probably be commenced. The work is being carried out by the Portuguese Government under the Post Office and Telegraph Department, and the service when completed will be run by this department."

CONTRACTS OPEN and CLOSED.

OPEN.

Aberaman.—September 11th. Electrical fittings for the Powell-Duffryn Steam Coal Co., Ltd., 101, Leadenhall Street, London, E.C. (form No. 26). Stores Manager, Aberaman, near Aberdare.

Australia.—VICTORIA.—September 5th. (*a*) 10,000 protectors, and (*b*) sundries, for the P.M.G.'s Department. See "Official Notices" July 28th.

MELBOURNE.—October 3rd.—42 miles of paper-insulated, lead-covered telephone cable, for the P.M.G. See "Official Notices" August 18th.

WESTERN AUSTRALIA.—October 18th. 20 coin-in-the-slot attachments for the P.M.G. See "Official Notices" August 25th.

September 26th.—30 miles of paper-insulated telephone cable, also supply of various telephone material. Local representation. Deposit, with tender, 5 per cent. up to £1,000 and 2½ per cent. above. Specification, &c., may be seen at Office of High Commissioner, in London, 72, Victoria Street, S.W.

SOUTH AUSTRALIA.—October 25th. Cable and paper sleeves for the P.M.G. See "Official Notices" to-day.

TASMANIA.—October 2nd. Porcelain insulators for the P.M.G. See "Official Notices" to-day.

Austria.—September 29th. International tenders are invited for the supply of a new electric station equipment at Budapest, comprising two turbo-generators of 5,000 KW. each, boilers up to a capacity of 5,000 KW., piping, central transformer station plant, crane for engine house, and coal-conveyor plant. Particulars to Dr. Johann Buzath, Präsidial Section des Magistrats, Városház-ucka II St. 1, Budapest. Guarantee, 50,000 marks.

Belgium.—November 27th. The municipal authorities of Tournai are inviting tenders for the concession for the supply of electrical energy for lighting and power purposes in the town during a period of 30 years. The specification can be obtained at the price of one franc from the Hotel de Ville, Tournai.

October 3rd.—La Société Nationale des Chemins de Fer Vicinaux, of Brussels (14, Rue de la Science), is inviting tenders for the contract for the overhead equipment of the Salzinnes-Malonne section of the Onoz-Profondeville light electric railway.

October 4th. Tenders are invited by the same society for the installation of electric traction on the Brussels to Halcht suburban line. The works comprise overhead equipment, sub-transformer station, electric locomotives, &c.

September 13th.—Tenders are also invited by the same society for the overhead equipment of the extensions of the Charleroi-Jumet line.

Brazil.—November 14th. Tenders are invited by the municipal authorities of Pelotas for a 40 years' concession for the supply of electric power and light, and the establishment and working of electric tramways in the town. Tenders to Senhor Luiz M. da S. Pennafiel, Secretario, Intendencia Municipal, Pelotas. A deposit of 5,000 milreis (about £330) is required with each tender, to be increased by the successful tenderer to 25,000 milreis (about £1,670). Further particulars (in Portuguese) may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, London, E.C.—*Board of Trade Journal*

Cleethorpes-with-Thrunscoe.—September 2nd. Vulcanised bitumen distribution and feeder cables, for the U.D.C. See "Official Notices" August 11th.

Denmark.—September 4th. Danish State Railways Administration. 936 accumulators for electric train lighting. Tenders, marked "Tilbud paa 936 Stk. Akkumulatorer til elektrisk Togbelysning," to "Direktören for Maskinafdelingen, Gl. Kongevej 1 D, 3 Sal," Copenhagen B. A specification, &c., (in Danish), and a drawing, may be seen at the Commercial Intelligence Branch of the Board of Trade, 73, Basinghall Street, E.C.

Dublin.—September 7th. 750 single-phase and 200 three-phase A.C. meters for the Electricity Supply Committee. See "Official Notices" August 25th.

Eccles.—September 12th. High-tension single-phase alternating-current switchboard, consisting of three generator and five feeder panels, for the T.C. H. W. Angus, electrical engineer, Cawdor Street, Patricroft; returnable deposit of £1 1s.

Haslingden.—September 9th. Electric light installations for various public buildings, for the Corporation. See "Official Notices" to-day.

London.—September 2nd. Battery boosters and switchboards for the Westminster Electricity Supply Corporation, Ltd. See "Official Notices" August 18th.

Ostend.—September 18th. Tenders will be received up to September 18th (instead of August 11th) for the supply and erection of electric lighting apparatus in the port of Ostend. Particulars, Bureau des Adjudicatures, Rue des Augustins, Brussels.

Penang.—September 5th. One 500-KW. steam dynamo (engine or turbine), with ejector condensing plant and switchgear, for the Municipality of George Town, Penang. See "Official Notices" August 11th.

Pontypridd.—September 12th. Water-tube boiler and Foster superheater for the U.D.C. See "Official Notices" to-day.

Roumania.—November 6th. The municipal authorities of Tulcea are inviting tenders for the concession for the electric lighting of the town.

Russia.—October 1st. The T.C. of Syzrane is prepared to accord a concession for the establishment of electric tramways and public lighting, or for the lighting separately. The city, which is situated on the Volga, has a population of 45,000, and the railway from Siberia-Moscow-Irkutsh makes a junction there with the line to Viarma. Tenders must be addressed to the "Ouprave Municipame" at Syzrane.—*Revue Pratique de l'Electricité.*

Tenders are invited by the T.C. of Omsk for a concession to erect and work an electric tramway and lighting service.

Sheffield.—September 9th. Clothing for the Corporation Tramway Department. General Manager, Tramway Department, Division Street.

Swinton and Pendlebury.—September 9th. Electric cables, joint boxes, compound, &c., for the U.D.C. See "Official Notices" to-day.

Wishaw.—September 11th. Carbons for Oriflamme arc lamps for the T.C. See "Official Notices" to-day.

CLOSED.

Aldeburgh.—The T.C. has arranged with Messrs. Christy to instal and maintain the necessary electric motors for driving the pumps at the sewage and water works, at £348, payable by 12 quarterly instalments of £29.

Birkenhead.—The Electrical Power Storage Co. has received the Corporation contract for supplying a new Battery of 260 cells, 1,500 ampere hours capacity, at £1,771, and maintenance for 10 years.

Bispham.—The D.C., on August 24th, settled the following contracts in connection with the electric lighting undertaking:—

Engines and dynamos.—National Gas Engine Co.
Switchboard, balancers, and boosters.—Messrs. Kelvin & James White, Ltd.
Storage battery.—Premier Accumulator Co., Ltd.
Mains.—British Insulated & Helsby Cables, Ltd.
Erection of station buildings, &c.—Chadwick Bros.
Making approach roads to the station, cable trenches, &c.—Messrs. Smith Bros. (Burnley) Ltd.

Devonport.—The Corporation has placed with the Electrical Power Storage Co., Ltd., the contract for renewing 261 cells of the lighting battery having a capacity of 670 ampere hours, also renewing part of the traction battery, each cell having a capacity of 2,000 ampere hours (£1,024), also maintenance of same for 10 years.

Farnham.—The tender of Messrs. Goddard & Son, of Farnham, has been accepted for the erection of the generating station for the Farnham Gas and Electricity Co. The electric light works are expected to be in operation by February next.

Haslingden.—The Education Committee has accepted the tender of Messrs. Siemens Bros. & Co., Ltd., for 10 motors to drive the looms in the weaving shed.

Huddersfield.—The T.C. has accepted the tender of the United Electric Car Co., Ltd., for 10 new car bodies, and of Messrs. Dick, Kerr & Co., Ltd., for the electrical equipments.

Keighley.—The T.C. has accepted the offer of the Tudor Accumulator Co., Ltd., to cancel the contract for the maintenance of the storage battery at £118 per annum, to double the capacity of the battery, supplying suitable switchgear and booster for operating the gear, and to enter into a fresh 10 years' purchase and maintenance contract for the enlarged battery, the Council to pay £302 per annum.

Walsall.—The T.C. has accepted the tender of Messrs. Storey & Sons, Ltd., for two sets of condensing plant, at £1,163.

FORTHCOMING EVENTS.

National Electrical Manufacturers' Association (Inc.), Balfour House, Finsbury Pavement, E.C.—Thursday, September 7th. At 2.30 p.m. Meeting of Council.

NOTES.

The Electrical Exports of Germany.—Although the modes of employment of electricity in Germany have been greatly widened and large schemes have been carried out during the current year, abroad Germany's exports have only found a restricted market, and the expansion of last year has been followed by a swift reaction. Notwithstanding that the quantity of electrotechnical products exported has been noteworthily larger than in the previous year, the value has proved appreciably inferior. This is strikingly shown by a comparison of the exports in the first half of the last five years :—

	Quantity. Double centner.	Value in 1,000 Marks.
1907	301,440	71,089
1908	381,812	88,760
1909	370,867	81,862
1910	418,428	101,551
1911	457,518	97,978

Contrasted with the quantities exported last year, which show an increase of 9·4 per cent., the values for the same period indicate a decline of 3·5 per cent. In fact, the double centner (q.) only yielded a value of 214 Marks, as against 243 Marks in the previous year. Although this price is purely arithmetical, the downward tendency is sufficiently attested. Contrasted on a similar basis, the downward tendency of values in the past five years is shown to be almost continuous :—

1907.	1908.	1909.	1910.	1911.
235	233	221	243	214

This year's figures are thus by far the lowest, and sensibly less than those of last year.

The question arises, what export products of the electrotechnical industries are specially responsible for this alteration. A single glance shows that of all the products those of cables for electrical transmission have undergone the most unfavourable development. The export quantities have, it is true, largely exceeded the averages ; this year they totalled 184,033 q., against 159,101 q. in the first half of 1910, or nearly 16 per cent. increase ; but the value has gone down from 23,060,000 marks to 18,917,000 marks, or 18 per cent. The cable exports are indeed a record this year, but the values have never been so low in any of the previously cited years. This is shown by a comparison of the leading export article taken over the past five years :—

	Quantity (double centner).	Value (1,000 Marks).
1907	135,395	23,694
1908	152,585	26,702
1909	169,672	24,602
1910	159,001	23,055
1911	184,033	18,969

The average value of the double centner, which figured for 175 Marks in 1907 and 1908, sank this year to 103 Marks.

The export of complete armatures and commutators betrayed the same tendency. There were exported this half-year 22,246 q. against 18,969 q. last year, showing expansion at the rate of 17·3 per cent. Values, however, remained practically unaltered, being 4,743,000 marks against 4,742,000 marks last year. The increase, which is inappreciable, has consequently no relation to the increase disclosed by the quantities. Comparing, moreover, the figures with those of 1907, while the quantities exported have nearly doubled, the values show a falling off of about 40 per cent.

The export of dynamos in the first half of this year was to the extent of 139,851 q., against 136,958 q. in the previous year, with a value of 20,400,000 marks, against 17,690,000 marks. Although, however, in comparison with the previous period, the advance in the values is greater than in the quantities, the relations to the foregoing years disclose the same drift as with the other products named. This is clearly shown by the following figures :—

	1907.	1908.	1909.	1910.	1911.
Quantity ...	88,020	134,608	104,573	136,985	139,851
Value	14,956	22,090	13,341	17,691	20,399

The increase in the exports from 1907 to 1911 amounted to 59 per cent., while that of the values was only 36 per cent. This variation between quantities and values is repeated in a whole series of articles, as, for example, light reflectors, dispersers, &c., whose volume in the current year was only 8 per cent. behind that of its predecessor, while the value was as much as 48 per cent. lower than in 1910.

More important, however, is the contrast which the participation of various lands in Germany's export trade shows. A single fact stands out clearly—namely, that those lands which hitherto have loomed largest in the export trade—viz., British South Africa, Belgium, Argentina, Italy and the Netherlands—have appreciably reduced their purchases. This is demonstrated by the following statistics :—

	1910.	1911.	*Decrease.*
British South Africa ...	48,392	21,468	27,464
Belgium	36,572	29,108	7,464
Argentina	36,237	33,875	2,362
Italy	27,693	26,644	1,049
Netherlands	26,557	24,461	1,996

Very pronounced, it will be seen, is the fall in the exports to British South Africa, mainly on account of the decline in the number of dynamos exported thither. Observably lesser shipments of dynamos to Belgium have also occurred. The countries taking fewer exports are not, however, exhausted by the list given, and the following record tangible reductions in their purchases :—

	1910.	1911.	*Decrease.*
France	16,065	9,752	6,313
Spain	8,917	8,728	189
Brazil	7,260	7,202	58
Switzerland ...	7,133	5,612	1,521
Mexico	5,897	4,494	1,403
Chile	4,525	4,398	167

France, in particular, shows a noteworthy retrogression, not only in her imports of dynamos, but of complete armatures, arc lamps, glow lamps, &c. Switzerland's and Mexico's declines are principally in large dynamos, glow lamps, &c.

The countries to which Germany's exports disclose noteworthy increases are not very numerous. Japan takes the first place, then follow Great Britain and Norway. The Japanese market shows a quite unusual power of absorption, for while last year only 21,701 q. of electrical goods were shipped there, this year more than double were dispatched, viz., 65,002 q. Of dynamos alone Japan took as much as 18,361 q., against 3,945 q. in the previous year ; of cables, she took 32,866 against 13,863 q. ; of electric accumulators 8,393 q., compared with 3,405 q., and electric light fittings 4,551 q., against 498 q. The exports to these several countries grouped in order of the importance of the shipments were as follows (double centner) :—

	1910.	1911.	*Increase.*
Japan	21,701	65,002	44,301
Great Britain ...	21,525	26,532	5,007
Sweden	20,609	22,263	1,654
Austria-Hungary ...	18,691	20,683	1,992
European Russia ...	15,340	16,963	1,623
Norway	9,612	13,064	3,442

Norway's heaviest imports this year were dynamos ; those of Great Britain were dynamos and complete armatures and cable equipments.—*Elektrotechnik und Maschinenbau.*

Cricket.—The "Tantalum" Athletic Cricket Club was on Saturday engaged in a match against the "Brimsdown" Imperial Lamp Works Cricket Club. The match was played on the "Tantalum" ground at Stamford Hill, and the visiting team batted first, making a total of 30 runs, 20 of which were actually scored off the bat, the remaining 10 being extras. In reply the "Tantalums" made a score of 128 for five wickets, thus handsomely winning the game.

Tramcar Accident Claim.—At the Court of Session, Edinburgh, on August 23rd, before Lord Johnston, the case Fife *v.* Musselburgh and District Electric Light and Traction Co., Ltd., was mentioned. Intimation was made of the settlement of the action. Plaintiff had claimed £750 damages in respect of personal injuries. The action was settled by a payment of £100 and expenses to the pursuer.

A French Experimental Furnace.—According to the *Revue Pratique de l'Electricité*, the Creusot Works have relinquished the trials—which were never seriously prosecuted—with the Saladin induction furnace in order to build a 1,000-H.P. arc furnace of a special type, with suspended electrodes

Installation Monopoly in Germany.—An example of the manner in which a monopoly of installation work is still sought to be established in Germany, notwithstanding the Prussian Ministerial order issued a year ago instructing Government officials to oppose any open or other attempt to secure a monopoly in installation work or the supply of apparatus or materials in connection with installations of prospective consumers has just occurred in Silesia. The local authorities of Schweidnitz, Reichenbach, Neumarkt, Jauer and Striegau have formed themselves into a company to establish the Central Silesian Overland Central Station, which is to purchase a supply in bulk and is to be leased to an electrical manufacturing firm. A notice has just been published in a Striegau local newspaper under the signature of an administrative official, stating that when the scheme for the distributing network has been settled, the names will be announced of the installation firms who will be permitted, in addition to the manufacturing company in question, to undertake house installations for connection with the mains of the overland station. The persons interested are warned before the particular firms are mentioned not to enter into negotiations with firms other than the manufacturing company or to conclude any contracts of any kind, as their validity might be placed in question by the decisions to be arrived at by the company owning the station. The Association of Electrotechnical Special Works, in drawing attention to this instance, submits that all the remunerative contracts will devolve upon the manufacturing company, leaving scarcely any profitable business when other installation firms are permitted to enter the arena after the network scheme has been settled. The question of the monopolistic tendency in the electrical industry has also engaged the attention of the Strassburg Guild, which has adopted a resolution setting forth the conditions under which freedom of competition should be allowed to installation firms in the execution of work and the supply of materials in connection with overland central stations, and formulating the methods under which tests should be carried out. It has been decided to refer the question to a committee with a view to a suggestion being made in official circles that Imperial legislation should be enacted on the lines of the resolution, so as to be able to maintain the independence of installation contractors and their workmen.

Extensions at the Quarry Street Station, Chicago.—Important extensions have been recently effected in this central station, being necessitated by the rapid increase in the maximum load on the bus-bars. Thus, in 1908 the maximum load was 117,000 KW., a figure which rose, in 1910, to 182,000 KW. The present extensions comprise six machines, each of 14,000-KW. capacity. The output of the neighbouring Fisk Street station is 120,000 KW., and in north-west Chicago there is a station of equal capacity in course of erection, with units of 20,000-KW. capacity. The total output of the latter station is ultimately to be doubled.

The main building of the Quarry Street station is 495 ft. long, 200 ft. wide and 80 ft. high. The rooms for fuel storage and handling, boilers, turbines and switchgear are arranged along the building. Electric locomotives are used for fuel handling. Water-tube boilers are employed, arranged in two rows of eight; each unit has 4,850 sq. ft. heating surface, is provided with chain-grate stoker, and supplies steam at 240 lb. per sq. in. and 144° F. superheat.

Five-stage vertical Curtis turbines are used, running at 720-750 R.P.M. and direct coupled to three-phase, 9,000-volt 25-cycle and 12,000-volt 60-cycle alternators respectively. A vertical 5,000-KW. frequency transformer (25 to 60 cycles) enables either set of generators to help the other in case of need.

The switch room has three levels and a central switch gallery. On the ground level are the high-tension cables, the battery room and the exciter bus-bars; the central level contains the high-tension and distribution bus-bars, and on top are placed the generator lines and the group switches. The high-tension switchgear is built on the cellular system, and is divided into two groups of 300 amperes and 1,200 amperes capacity respectively.

Excitation is provided by two 150-KW. motor-generator sets, three steam turbine sets and two 125-volt auxiliary batteries. The exciter switchboards are placed in niches above the turbine room.

For operating purposes, the whole plant is divided into three sections, each of 60,000-KW. capacity, which are paralleled as required by the demand at various times of the day.

The western end of the switch house contains a sub-station with two 500-KW. rotary transformers. A 220-volt D.C. cable connects this sub-station with Fisk Street.

German Electric Trusts in Turkey.—The *Standard* correspondent in Berlin says:—"German financiers and industrial men are making strenuous efforts to secure a firm foothold for German enterprise in the new field offered by the regenerated Turkish Empire. The latest development is the formation of an electric trust among the German companies at present operating in Turkey and several of the leading German banks, the negotiations for which are now approaching completion. The new trust will have a capital of £2,500,000, and its chief component companies will be the Deutsche-Orient Bank, with its subsidiary companies, the Dresdner Bank and the National Bank, the Deutsche Bank, the Constantinople Electric Tramway Co., the Metropolitan Tunnel Co., and the Electric Light and Gas Co. in Constantinople."

Lock-out on the Continent.—A Reuter dispatch, dated August 26th, in the *Times* states that the negotiations in the metal trades conflict at Dresden have been broken off. The masters carried out their threat and locked out 60 per cent. of their employés at Dresden and Chemnitz.

A Miniature Electromotor.—The miniature electromotor recently constructed by M. G. Trevet, at Bellevue, France, works most satisfactorily in spite of its marvellously small dimensions, and has, therefore, been presented by M. Carpentier to the French Academy of Sciences. This motor is a shunt-excited machine with Gramme ring, the height of the field-magnet being 14·5 mm., width of base 14 mm., and length of shaft 15 mm. The field magnet coil comprises 600 turns of wire, 0·05 mm. in thickness. The magnet iron is 15 mm. in cross-section and 33 mm. in average length. The armature, which is 6·2 mm. in diameter, has 12 teeth; its windings are subdivided into six sections, and, with 288 turns, have a useful length of 1·67 metres. The commutator comprises six plates kept together by two ivory cones and insulated by six ebonite plates, the whole being screwed with a hexagonal nut on a brass tube forced upon the shaft. The leads are connected to minute terminals, the commutator diameter being only 2·8 mm. Each of the brushes consists of two plates kept together by three riveted cross stays and pressed against the commutator by a ring, screw and spring. A piece of silver—in place of the carbon used in actual practice—serves to effect the contact. The brushes are 3 mm. long, 1 mm. wide, and 0·7 mm. thick. The brush-holders are adjustable, connection with them being made by perforated screws. The steel shaft is 0·8 mm., and the bearings only 0·4 mm. in diameter. The motor in full operation takes 0·2 ampere at 3·5 volts, that is, 0·7 watt. Its total weight is only 7 grammes.

Electric Pumping in Tin Mines.—At the half-yearly meeting of the Dolcoath Mine, Ltd., on Saturday, Mr. Frank Harvey presiding, Mr. R. S. Hosken (Penryn) inquired if the management were satisfied that electric pumps were going to fulfil the object for which they were being installed, bearing in mind that electrical pumping at Wheal Vor caused a good deal of trouble at one time. Mr. Arthur E. Collins asked if the manager thought it would pay Dolcoath to have its own generating station. Replying, Mr. Arthur Thomas said that at the present price of tin they were working stuff which could not be worked if the price were very much lower. As regarded Mr. Hosken's question, they had guarantees from the makers as to the efficiency of the electric pumps. They were of a type entirely different from the first pump at Wheal Vor, and, he thought, would prove absolutely reliable and efficient. Having an agreement more or less of a private nature, it was inadvisable for him to mention the price Dolcoath was paying for electrical energy. The matter of a generating station for the mine had been gone into very carefully, and the decision arrived at—which he thought to be a very sound one—was that it would be better to keep in the locker the capital of £20,000 to £25,000, necessary for the laying down of such a station, and await developments.

Bridge Strengthening.—Tramway engineers may sometimes be called on to strengthen a bridge without stopping the traffic over it. They might take a note of the bridge strengthening that has just been carried out on the Chatham and Dover Railway near Walworth. There an old plate girder bridge has been practically made into a new and much stronger structure without any disturbance of the traffic. To effect this a horizontal-built beam or top boom was erected 10 ft. or so above each bridge girder and supported on the ends of these by sloping junction columns or diagonals, and then the old plate girders and the new upper chord were connected by a system of web members. In this way there are now a pair of truss girders, the upper chords of which are new and the lower chords are the old plate girders, which are amply strong to carry the tensile load of what are now the bottom members of deep trusses, and are also well supported by the new diagonal bracing in carrying the floor beam load. The whole work appears to be a cheap and efficient means of getting over a difficulty with a minimum of inconvenience, and is worth noting, for many old and shallow plate-girder bridges could thus be treated. It must be a very weak plate girder indeed which is not fit for the service of tension member in a bridge of double its own depth.

Wiremen's Agitation in Berlin.—An agitation for improved conditions is proceeding among the wiremen in Berlin, and is being conducted by the German Metal Workers' Union. A form of contract which the union asks that the installation firms shall observe in relation to the wiremen and assistants employed by them was recently submitted to the contracting firms for signature, and it was intimated that a strike was in prospect in case of refusal. Some of the contractors belong to the Syndicate of Electrotechnical Installation Firms, but quite a number, including the large manufacturing firms, are not connected with it. It is stated that some firms have now signed the proposed agreement as to working conditions, but others have not done so, and these comprise to some extent the more important contractors. Nevertheless, it is said that from the course of the negotiations down to the present time there is no need to fear the occurrence of a general strike.

Accidents.—It is reported in the papers that on Saturday last two of the Glasgow Corporation electricity works employés, a hoistman (David Roxburgh) and a motor-car driver (W. Donelly), met with an accident while out in one of the department's motor-cars. Some distance outside Glasgow the car skidded downhill and collided with a tree, Roxburgh being killed and Donelly injured.

Inquiry.—A wholesale supply firm requires names of manufacturers of Presspahn and Leatheroid. Makers of the "Pragnell" electric adapter are asked for.

Electric Power in Textile Mills.—In view of the great interest which has been aroused with regard to the application of electric power to the driving of textile machinery, as evidenced among other things by the very complete inquiry which is now being made into the subject by representatives both of the textile and the electrical engineering industry, it may be worth while to mention briefly an experience of technical interest which occurred in connection with a textile factory. This was equipped electrically by installing a number of direct-current motors, but a difficulty arose owing to the fact that, in the particular operation carried on in the factory, it was absolutely essential that the machines should run at constant speed. The motors which had been installed were of the shunt-wound type, and it was observed that after these had been at work for some time, the speed gradually increased, in some cases by as much as 5 or 10 per cent. This speed increase was, of course, due to the warming up of the field circuit winding and the consequent weakening of the magnetic field. It was judged inexpedient to add any shunt regulating resistances in order to correct this speed variation, inasmuch as it was not thought desirable to give power to the operatives to vary the speed of the motors by hand, so it was decided to use instead an alternating-current supply which was available, and to install induction motors, which, as the load on the machines was approximately constant, maintained their speed constant within very narrow limits.

Soldering with Acid Flux.—A rather curious source of error which occurred in a central station testing department in connection with bridge measurements may be of interest to other station men, in order to keep them on their guard against a similar occurrence. The testing engineer, while using a form of Wheatstone bridge, found that there was a fluctuation in the currents which upset his balances, and for which he could not account. He eventually, however, traced the fault to a terminal of the bridge, this terminal, to which one wire was attached, being fixed on the top of a marble base. On the under side of this base were two other wires and also a metal strip, all of these being connected to the terminal by means of a brass bolt which screwed into the terminal for about ½ in. In order to secure efficient connection between the various circuits, the head of the bolt, the wires, and the copper strip had all been soldered together. The bridge had been in use for some years, and the terminal on casual inspection appeared to be quite sound. On closer examination, however, it was discovered that an acid flux which had been used in the sweating had crept up the thread of the brass bolt, and had eventually eaten it away to such an extent that it only made an intermittent contact with the terminal, thus throwing the readings into confusion. It was, of course, a fault which was easily set right, but it is well to remember that acid is not a good thing to use in soldering electric circuits. That which could occur on a measuring instrument might also happen on a power circuit, with unpleasant results.

Water Polo.—A water polo match took place at Great Smith Baths last Tuesday between the London Electrical Engineers and the City of Westminster Swimming Club. A good game resulted in a win for the latter by 5 goals to 2.

Appointment Vacant.—Works superintendent for the English Electric Works, Preston, Lancs. See our advertisement pages to-day.

Institution and Lecture Notes.—Institution of Municipal Engineers (Southern District).—This Institution will meet at Lewes and Seaford on Friday, September 8th, commencing at 11 a.m. with an inspection of the engineering and steel construction departments at the Phœnix Ironworks, Lewes.

Institution of Mining Engineers.—The annual general meeting will be held at Cardiff on September 13th. Among the papers to be read is one by Mr. Sam Mavor, on "The Reduction, Control and Collection of Coal-dust in Mines," and one by Mr. W. Maurice, on "A Rope-driven Coal-cutter." Various interesting visits have been arranged, including several electrical installations, which figure prominently in the programme.

Educational Notices.—Crystal Palace School of Practical Engineering.—The new course will commence on Wednesday, September 13th. Principal, Mr. J. W. Wilson, M.I.C.E., M.I.Mech.E.

Goldsmiths' College (University of London).—The new session commences on September 25th (enrolling September 18th). Complete evening courses in mechanical and electrical engineering are provided; Mr. W. J. Lineham is head of the department. An announcement regarding the College is published in our advertisement pages to-day.

The Electrical Standardising, Testing and Training Institution (Faraday House).—We have received an illustrated pamphlet relating to the Institution, which gives full particulars of the staff (of which Dr. Alexander Russell is the principal), appointments held by old students, and the courses of training provided for present and future students. As is well known, the Faraday House Institution has for many years practised the "sandwich" system, being associated with over 70 engineering concerns, which receive the students during the second and fourth years of their course of training. The excellence of the system has been amply demonstrated by the many successes achieved by the students, and the facilities for instruction afforded by the new establishment and its equipment are well calculated to enable the Institution to maintain its honourable position. A list of testimonials from parents and old students, and the Electrical Engineering Syllabus, have also come to hand; the latter gives detailed information as to the courses of instruction, fees, &c. The next term commences on September 25th.

Colliery Hooligans.—A somewhat serious charge was preferred against some youths at Seaham Harbour Police Court on August 25th, when James Dent and James Rowe, employed at Dawdon colliery, were charged with having extinguished the electric lights at the shaft bottom on August 25th. William Jeff, an "onsetter," stated that on the morning named about 60 youths and others went to the shaft bottom to go to bank in the cage. There was much crushing, and witness ordered them back. There was a little disturbance, and meanwhile the lights were frequently extinguished. John Harper, a wagon-way man, said he saw the two defendants extinguish the lights. Each defendant was fined 2s. 6d. and costs.

Sports.—The sixth annual sports of the Robertson and Osram Social and Athletic Club are to be held to-morrow, Saturday, September 2nd, at 2.30 o'clock sharp, on the ground of the Latymer Upper School, Wood Lane, Shepherd's Bush.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry, also electric tramway and railway officials, to keep readers of the Electrical Review *posted as to their movements.*

Central Station Officials.—On 26th inst., Mr. F. H. Brandreth, who for the last three years has been chief assistant at Grantham, was presented by the staff with a case of razors, and a silver-mounted walking stick. Mr. J. E. Edmundson, in making the presentation, referred to Mr. Brandreth's good work in Grantham, and wished him success in his new sphere as resident manager at the Electric Light Works, Stamford.

Mr. C. W. Jackson, of the Ipswich Corporation Outside Department, has been appointed chief assistant engineer to the Grantham Electric Light Works, in place of Mr. Brandreth, who has gone to Stamford.

General.—The Telephone Committee of the Portsmouth T.C. has decided to increase the salary of the engineer and manager (Mr. H. J. Andrews) from £260 to £300 per annum, by £20 a year for two years.

Obituary.—We regret to state that the death occurred early in August of Mr. William Dunlap Sargent, who was for many years vice-president and general manager of the New York and New Jersey Telephone Co., and latterly in charge of the Brooklyn branch of the New York Telephone Co. Mr. Sargent was born in 1845.

NEW COMPANIES REGISTERED.

Ardrossan and Saltcoats Electric Light and Power Co., Ltd. (7,959).—This company was registered in Edinburgh on August 11th, with a capital of £20,000 in £1 shares, to carry on the business of an electric light, power and heat supply company. The subscribers are:—G. Balfour, M.I.E.E., 22a, College Street, Cannon Street, E.C., 100 shares; A. H. Beatty, 22a, College Street, Cannon Street, E.C., contractor, 100 shares; R. F. Shepherd, 16, Charlotte Square, Edinburgh, W.S., 1 share; J. Balfour, 23, Heriot Row, Edinburgh, W.S., 1 share; J. W. S. Fullton, 50, Hamilton Place, Edinburgh, clerk, 1 share; A. T. Anderson, 5, Victor Park Terrace, Corstorphine, clerk, 1 share; W. Paterson Gray, Hillview, Davidson's Mains, cashier, 1 share. The number of directors is not to be less than two or more than six; the first are G. Balfour and A. H. Beatty; qualification, 100 shares. Registered office, 63, Castle Street, Edinburgh.

Weaverham Electricity Supply Co., Ltd. (117,358).—This company was registered on August 22nd, with a capital of £5,000 in £5 shares, to carry on the business of electrical engineers, electricians, manufacturers of and dealers in electrical apparatus, suppliers of electricity for light, heat or power, &c., in Weaverham and district. The subscribers (with 100 shares each) are:—J. W. Smith, Ivy House, Weaverham, medical practitioner; W. H. Burgess, Rose Cottage, Weaverham, merchant; G. H. Dean, Wallerscote, Weaverham, farmer; R. Howarth, Gate Inn, Weaverham, hay and straw merchant; R. N. Gandy, The Hollies, Acton Bridge, surveyor; A. Davies, Gate Inn, Weaverham, traveller; E. H. Herbert, Woodfield, Acton, yarn merchant. Minimum cash subscription, £2,500. The number of directors is not to be less than three or more than seven; the first are J. W. Smith, W. H. Burgess, G. H. Dean, R. Howarth and R. N. Gandy. Qualification, £100. Registered by Waterlow Bros. & Layton, Ltd., Birchin Lane, E.C.

Curtis & Co., Ltd. (117,400).—This company was registered on August 25th, with a capital of £2,000 in £1 shares (1,000 preference), to take over the business of an electrical engineer and medical electrician, &c., carried on by W. Curtis, at 24, York Place, Portman Square, W. The subscribers (with 150 preference shares each) are:—L. H. Rosenheim, 2, Lime Street Square, E.C., merchant; W. H. Rosenheim, 2, Lime Street Square, E.C., merchant. Private company. The number of directors is not to be less than two or more than five; the first are W. Curtis and Elma Curtis. Remuneration as fixed by the company. Registered office, 101, Leadenhall Street, E.C.

Darnell Acoustic Co., Ltd. (117,382).—This company was registered on August 24th, with a capital of £100 in £1 shares, to carry on the business of manufacturers of and dealers in electrical and other instruments for deafness, medicinal preparations or medical or surgical appliances. The subscribers (with one share each) are:—Mrs. G. Hincks, Jesmondene, St. Margarets; G. S. Clapp, 104, Teviot Street, Poplar, E., accountant. Private company. The number of directors is not to be more than five; Mrs. G. Hincks is permanent governing director. Registered office: 883, Mansion House Chambers, 25, Budge Row, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Bankfoot Power Co., Ltd. (98,134).—Issue on July 28th of £10,000 debentures, part of a series of which particulars have already been filed.

Cleveland and Durham Electric Power, Ltd. (89,539).—Issue on July 24th, 1911, of £28,000 debentures, part of a series of which particulars have already been filed.

Landaulet Co., Ltd. (72,890).—Return dated June 7th, 1911 (filed July 8th). Capital £50,000 in £10 shares: 3,928 shares taken up; £39,280 paid. Mortgages and charges, £6,000.

African Direct Telegraph Co., Ltd. (21,895).—Return dated June 14th (filed June 19th). Capital £300,000 in £10 shares; 28,600 shares taken up; £286,000 paid. Mortgages and charges, £8,600.

Lodge-Muirhead Wireless and General Telegraphy Syndicate, Ltd.—Particulars of £10,000 debentures, created July 21st, 1911, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the whole amount being now issued. Property charged: the company's undertaking and property, present and future, including uncalled capital. No trustees.

Electromobile Co., Ltd. (75,139).—Particulars of £11,807 debentures, created August 3rd, 1911, filed pursuant to Sec. 93 (3) of the Companies' (Consolidation) Act, 1908, the amount of the present issue being £6,566 18s. 11d. Property charged: the company's undertaking and property, present and future including uncalled capital. No trustees.

Issue on August 3rd, 1911, of £10,000 debenture stock, part of a series secured by trust deed dated December 9th, 1908, between the North of England Trustee, Debenture and Assets Corporation, Ltd., and this company also registered. The stock was limited in the first instance to £40,000, but has now been increased to £50,000.

Shanghai Electric Construction Co., Ltd. (86,795).—Return dated May 18th, 1911. Capital £320,000 in £10 shares. All shares taken up. £317,000 paid. £3,000 considered as paid. Mortgages and charges, nil.

Anchor Cable Co., Ltd. (69,073).—Return dated June 6th, filed June 7th, 1911. Capital £250,000 in £10 shares; 6,500 shares taken up; £10 per share called up on 4,600, and £5 per share on 1,500; £53,500 paid; £4,000 considered as paid on 400 shares. Mortgages and charges: £50,000.

British Electric Automatic Machines, Ltd. (109,404).—Return dated July 28th, filed August 9th, 1911. Capital £150,000 in 200,000 pref. and 400,000 ordinary shares of 5s. each; 30,000 pref. and 5,280 ordinary shares taken up; 5s. per share called up on 10,000, and 1s. per share on 20,000; £8,259 paid, leaving £241 in arrears; £1,320 considered as paid on 5,280 shares. Mortgages and charges: Nil.

Electricity Supply Co., for Spain, Ltd. (29,103).—Return dated July 4th, 1911. Capital £105,000 in 20,000 pref. shares of £5 each and 9,900 ordinary and 100 founders' shares of 5s. each; 17,330 pref., 19,900 ordinary, and 100 founders' shares taken up; 5s. per share called up on 19,900 ordinary; £4,975 paid; £86,675 considered as paid on 17,330 preference and 100 founders'. Mortgages and charges: £131,400.

Electromotors, Ltd. (60,826).—Return dated June 1st, 1911. Capital £50,000 in £1 shares. 42,370 shares taken up. £1 per share called up. £39,195 4s. paid, leaving £3,174 16s. in arrears. Mortgages and charges, nil.

Heswall Electric Light Co., Ltd. (55,482).—Return dated May 31st, 1911. Capital £1,500 in £1 shares. 1,225 shares taken up. £1 per share called up. £1,225 paid. Mortgages and charges, nil.

Gorseinon Electric Light Co., Ltd. (39,944).—Return dated June 3rd, filed June 29th, 1911. Capital £4,000 in £1 shares. 2,000 shares taken up. £1,998 paid, leaving £2 in arrears. Mortgages and charges, £800.

Europe and Azores Telegraph Co., Ltd. (39,452).—Return dated July 12th, filed July 18th, 1911. Capital £200,000 in £10 shares. All shares taken up £10 per share called up on 14,432. £144,320 paid. £55,680 considered as paid on 5,568. Mortgages and charges, nil.

Llanelly and District Electric Lighting and Traction Co., Ltd. (64,341).—Trust deed dated August 3rd, 1911, to secure £60,000 debenture stock, charged on lighting and tramway undertakings, leasehold power station and shed, and company's other assets, including uncalled capital. Trustees: Century Insurance Co., Ltd., 18, Charlotte Square, Edinburgh.

A memorandum of satisfaction in full on August 8th, 1911, of charge dated March 22nd, 1911, securing £25,000, has been filed.

Dawlish Electric Light and Power Co., Ltd. (108,147).—Debenture dated July 25th, 1911, to secure £2,000 charged on the company's undertaking and property, present and future, including uncalled capital. Holders: The Capital and Counties Bank, Ltd.

J. Stone & Co., Ltd. (80,901).—Return dated June 22nd, filed June 29th, 1911. Capital £700,200, in 30,000 preference shares of £10 each, and 400,200 ordinary shares of £1 each. All shares taken up. £200,000 paid on 20,000 preference. £500,200 considered as paid on 10,000 preference and 400,200 ordinary. Mortgages and charges: Nil.

CITY NOTES.

Perth Electric Tramways, Ltd.

THE annual meeting of this company was held on Tuesday, at the offices of the London Chamber of Commerce, Salter's Hall Court, Cannon Street, E.C., Mr. A. H. P. Stoneham presiding.

The CHAIRMAN, in proposing the adoption of the report (see ELECTRICAL REVIEW, page 309), said that as the meeting was very late this year, the shareholders would doubtless like to know the returns for the eight months of the current year ended August 25th. He was pleased to say the figures were £10,300 ahead of the corresponding period of last year, but as the figures then were affected by the strike, the most useful comparison was to compare the returns with those for the corresponding eight months of 1909, on which they showed an increase of £6,700. The delay in holding the meeting had arisen owing to the fact that during the last three months the board had been occupied in negotiations as to the disposal of the tramways. The fact was that Perth had increased so tremendously during the last few years that the people had come to the conclusion that they ought to own the tramways. They, as directors of the company, of course took quite a different view. They thought that, seeing they had had 10 years of struggle, and were just on the point of getting 10 years' rich reward, that they ought to be left in peace to reap the reward which they considered they had so justly earned. They had always done their duty to the public; they had not only kept to their contract, but had, in fact, largely exceeded their obligations or their intentions. When the concession was granted to the company it was for 17 miles of track; they were now operating over 30 miles. They recognised that they had a certain duty to the public, and they had entered upon those extensions in that spirit, and believing that in future years they would benefit the shareholders. They were informed by their engineers that some of those extensions could not possibly pay them until after an interval of two or three years, but that they were advisable in the interests of the public. For two or three years they were unprofitable, and now, just as they were beginning to become profit earning, it seemed rather hard that the company should be assailed by the public as if they had done them an injury instead of having done them a service. He was glad to say that the Mayor of Perth, Mr. Molloy, who had been in London for some months, had admitted that the company had done its work well, and that the Perth tramways were as good as any he had seen in his travels, and he was also good enough to admit that if they consented to sell they ought to have a reward for their enterprise and the risks they had run. Mr. Molloy told them that the people in Perth would not stand the means of locomotion being in the hands of private enterprise any longer, and he asked them to name a price at which they would be willing to sell the undertaking to the City Council. They naturally said: We have a very good business, and we don't want to sell, but if the circumstances are like what you say, and there is going to be dissatisfaction among the public, rather than have any trouble, we shall recommend the shareholders to sell, if only a fair price is given to us, but we want a bid from you. It subsequently appeared that, although it was quite true that there was a very strong feeling in Perth that the tramways should be acquired for the use of the public, the opinion seemed to be in favour of a purchase by the State rather than by the City Council, and that being so, as the Premier happened to be in London for the Coronation, he (the chairman) took the opportunity of asking him what the views of the Government were on the matter. Of course, he had to be very diplomatic, but he said he believed there was a feeling in the City that the Government should acquire the tramways. The Premier returned to Perth about the commencement of July, and in his opening speech for his election campaign, he stated that proposals would be submitted for the nationalisation of the Perth tramways. Before the Premier left this country, he (the chairman) and Mr. Wethered had a very long conversation with him on the subject, and he asked what price they would take. He (Mr. Stoneham) told him that, of course, he could not bind the shareholders, but that having consulted several of the large holders he would not recommend them to take anything less than £500,000. He thought they would agree that that was a very low price to ask for the undertaking. They certainly had 15 years to run before the Council had the right to buy them, and at the end of that term the price which the Council would have to pay was to be settled by arbitration. They had taken the opinion of the best experts whom they could find in London to try and find out approximately about what price they would get at the end of that period, and, as far as they were advised, they would receive about £750,000. He thought, therefore, that in consenting to a sale for £500,000 they were asking a very moderate price. The State would purchase a going concern earning a very large amount of money, and they would save about £2,500 or £3,000 in London expenses. Their profits in 1909 were £30,161, and if they added the London charges (£3,103) they had a total profit of £33,260. For the year 1911 things would be much better, provided the company continued to go on as it was now doing. The profits up to the end of June were £19,700, so that for the whole year they ought to be £39,400. The London expenses would have to come out of that, which would leave them about £37,000 at the end of the year as profit. They knew that the Government could borrow at 4 per cent., and 4 per cent. on £500,000 was only £20,000 a year, so that if the Government bought them for £500,000 they would have a profit of £17,500 a year, and they would also have an annual increase which they were entitled to expect, looking at the prosperity of Perth. Personally, he should be very sorry to sell for £500,000, or in fact to sell at all, but if they were going to have trouble with the city council and the State, they thought it would be better to consent to sell. If the Government insisted upon their selling, he thought they were entitled not only to a good price, but to the thanks of the people for what they had done in helping towards the expansion of Western Australia. It was not at all certain that they would sell, and he would be perfectly content if they did not. If they kept the enterprise, there was no doubt they must do something to keep pace with the increasing growth of the city, and that would mean more cars and duplications of the system and possibly extensions. They had not seriously considered that question, because of the pressure that was being brought upon them to sell, but he might say that they had had an offer of £50,000 of fresh capital on very fair terms if they decided to go on.

MR. C. WREN seconded the motion.

Replying to questions by shareholders, the CHAIRMAN said that if they received a definite offer of purchase, the directors would call the shareholders together at the earliest possible moment. As

to the basis on which the purchase money should be distributed among the ordinary and the preference shareholders, he agreed that technically the preference shareholders could only claim to be paid out at par, but he would remind them that in order to effect a sale it would be necessary to get the consent of both classes of shareholders. The preference shareholders would say: "We have got a safe 6 per cent., and unless you can find us 6 per cent. somewhere else we shall not sell." He reckoned that if they ever did come to sell, the preference shareholders would ask to be treated on the same footing as the holders of ordinary shares; but he had no doubt they would be able to come to some arrangement satisfactory to all parties. With regard to the use of motor omnibuses for suburban traffic in place of extensions, they had again had the matter examined by experts, and they were quite satisfied that it would be quite useless for them to attempt to run motor 'buses. The cost of running such vehicles in London amounted to about 7d. per mile, and that was over the very best roads in the world. In Perth, although the roads were fairly good, it would not be safe to count upon a less cost than 10d. or 11d. per mile, and on top of that there was the very heavy depreciation, and the fact that motor omnibuses could not carry so many people as the tramways. Having regard to all these considerations, their advisers strongly advised them not to have anything to do with such vehicles, as to do so would only lead to a huge loss of money.

The report was adopted.

Kalgoorlie Electric Tramways, Ltd.

The meeting of this company was held on Tuesday, at the offices of the London Chamber of Commerce, Oxford Court, Cannon Street, E.C., under the presidency of Mr. A. H. P. Stoneham.

The Chairman, in moving the adoption of the report (see Electrical Review, p. 308), said he was sorry to say that they had not very good results to record for the past year. The company was dependent upon Kalgoorlie and Boulder, both of which towns were entirely dependent upon the mining industry, and that industry unfortunately was not in the flourishing state that it was when the company was formed, and consequently their returns had suffered considerably. Under the circumstances, he was afraid he could not hold out any hope of any great improvement in the future. It all depended upon whether more mines were opened, and to a certain extent upon the construction of the Trans-Continental Railway, which might open up a fresh district, of which Kalgoorlie would be the centre. When the tramway was built some years ago, it was thought that Kalgoorlie was to be the centre for the whole district, but that had not turned out to be the case. As they could not make traffic the only thing they could do was to keep down the expenses, and they had been very materially reduced—in fact, they had been got down to such a point that they could not reasonably anticipate reducing them any more. The shareholders might recollect that they took their supply of electric power from the Kalgoorlie Power Co. That company from time to time had made propositions to them to work the tramways for them under an agreement at so much per mile, as they thought they could work them cheaper than the tramway company could. When they came to work the thing out, the Power Co. declined to enter into the agreement, and they had continued to purchase their power from them. He thought that was a pretty good proof that they were working the tramways as cheaply as possible. There was another possibility, which was that the State might acquire their undertaking. The tendency all through Australia was to nationalise the means of locomotion; but, as a rule, one found that the State only wanted to acquire a concern when it was exceedingly prosperous, and, unfortunately, they were not in that prosperous condition which was likely to excite the cupidity of the State.

Mr. O. Wethered seconded the motion.

The Chairman, in reply to questions, said that the meeting would have been held two months ago, but the directors thought it best to wait and see what policy the Government intended to adopt in regard to the nationalisation of the tramways in Australia. So far they had only decided upon acquiring the Perth tramways. With regard to paying a dividend on the ordinary shares, he would remind them that their credit balance, which at the end of 1909 was £4,982, was only £5,031 this year, so that they were only about £100 better off on the year. In the opinion of the directors it would be foolish to divide that £5,000 in paying a small dividend—it was far better to utilise it in paying off their debenture debt as quickly as possible. As to the London expenses, they had been kept at a fairly low figure, and all the directors reduced their fees by a large amount two years ago.

The report was adopted.

The Ottoman Union Company for Electrical Enterprises.

The report for 1910-11 of the Union Ottomane, Société pour Entreprises Electriques en Orient, to which reference was made editorially on August 25th, relates to the second year of the company's existence, and states that, in consequence of the lack of favourable opportunities, it was impossible to further extend the field of activity. The Société des Tramways de Constantinople remained the sole undertaking with which the company had been occupied. Three new lines had been provided for by the tramway company's convention of 1907, and two had been completed, and the third also as far as the width of the streets permitted. The network now amounted to a route length of 14·6 miles and a track length of 24·3 miles. At the beginning of the year, the company obtained sanction to use electric traction and also permission to connect its lines on both banks of the Golden Horn by means of a track laid across the new Karakouy bridge now in course of construction. In return, the company had agreed to pay to the City of Constantinople a certain tax per kilowatt-hour and a share in the profits. The necessary funds had been raised by the company calling up the unpaid amount of £T2 10s. per share, thus making the shares £T10 fully paid. By this means the interest of the Union Ottomane in the Constantinople undertaking had been considerably increased, and the Union had therefore concluded an agreement with the Deutsche Bank whereby the latter took over the advances and credit liabilities of the tramway. The new works undertaken by the tramway had interfered with the working, and the company had consequently only been able to pay a dividend of 3 per cent. on the share capital. It is added that the efforts of the Union to obtain the Constantinople concession for electric lighting and power supply were unsuccessful, the right having been secured by a Belgo-Hungarian (Ganz) group. As previously reported, the Union proposes to dispose of the tramway shares and go into liquidation in consequence of inability to extend the scope of the enterprise.

The Zurich Bank for Electrical Enterprises.

The report for 1910-11 of the Bank für Elektrische Unternehmungen, of Zurich, which is connected with the group of the A.E.G., and is the most important electrical investment company in Europe, states that the greatest transaction undertaken since the bank was formed, was the combination with the Electricity Co., formerly W. Lahmeyer & Co. Of the £1,250,000 of Lahmeyer shares, those representing £1,086,000 were exchanged for shares in the bank, which increased its share capital by £800,000, and allotted £651,600 to Lahmeyer shareholders, whilst the balance of £148,400 was issued to a banking syndicate and yielded a premium profit of £90,800. By the connection with the Lahmeyer Co., the bank obtained an extension of its sphere of interest from which advantage was expected, although the first year might not at once yield the financial results. The bank had also taken over from that company a large block of shares held by the latter in the Felten & Guilleaume Carlswerk, and had given shares in other companies in exchange. The accounts of the bank show the following figures for the past two years:—

	1910-11.	1909-10.
Share capital	£2,400,000	£1,600,000
Loan capital	2,094,000	1,920,000
Net profits	251,700	167,800
Dividend	240,000	160,000
,, per cent. ...	10	10

It will be seen that the loan capital, as well as the share capital, is greater than in 1909-10, an issue of £400,000 in 4½ per cent. bonds having been made last April. The report gives particulars of the many undertakings in which the bank is interested, and of the sales of shares and purchases of fresh securities.

Oxford Electric Co., Ltd.—A dividend at the rate of 6 per cent. per annum has been declared for the half-year.

Ibbotson Bros.—A final dividend of 6s. per share is recommended, making 10 per cent., tax free, for the year ended June 30th. £15,217 is carried forward. The same dividend was paid in the previous year.

Stock Exchange Notices.—The Committee has appointed special settling days as under:—

Wednesday, September 6th.—Ransomes, Sims & Jefferies, Ltd.—133,334 5½ per cent. cumulative preference shares of £1 each fully paid, Nos. 1 to 133,334; and £166,667 4½ per cent. first mortgage debenture stock.
Welsbach Light Co., Ltd.—£240,000 4½ per cent. debenture stock.

And ordered the undermentioned securities to be quoted in the Official List:—

British Insulated and Helsby Cables, Ltd.—£200,000 5 per cent. mortgage debenture stock.
Ransomes, Sims & Jeffries, Ltd.—Preference shares and debenture stock, as above.
Welsbach Light Co., Ltd.—Debenture stock, as above.

Application has been made to the Committee to allow the following to be quoted in the Official List:—

Marconi's Wireless Telegraph Co., Ltd.—Further issue of 37,600 ordinary shares of £1 each, fully paid (Nos. 428,776 to 466,675); and 227,011 7 per cent. cumulative participating preference shares of £1 each (Nos. 500,001 to 727,011).

Blackpool and Fleetwood Tramroad Co.—At a general meeting of the proprietors held at Fleetwood on August 24th, Mr. G. Richardson, the chairman, said the profits for the half-year, after paying debenture interest, were £5,782, against £5,277 for the corresponding period of 1910, an increase of £594, and the expenditure was less by £24. During the half-year they had taken from reserve £3,020 for renewals of cables and track, but they had, on the other hand, placed £1,750 to those accounts. They had still a sum nearly equal to the amount he had named, to spend on the track to complete the entire renewal. He formally moved the adoption of the report and the payment of a dividend at the rate of 4 per cent. per annum, absorbing £3,000, writing off a sum of £1,250 for depreciation, and £500 to the general reserve account, leaving a balance of £1,122 to be carried forward to the current half-year. This was agreed to.

MARKET QUOTATIONS.

Wednesday, August 30th.

CHEMICALS, &c.		Latest Price.	Fortnight's Inc. or Dec
a Acid, Hydrochloric	per cwt.	5/-	..
a " Nitric	"	22/-	..
a " Oxalic	"	28/-	..
a " Sulphuric	"	5/6	..
a Ammoniac, Sal	"	42/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	..
a " "	"	£30	..
a Bleaching powder	"	£5 10	..
a Bisulphide of Carbon	"	£18	..
a Borax	"	£16	..
a Ferro-Silicon (50 %)	"	£10 10	£2 dec.
a Copper Sulphate	"	£20	..
a Lead, Nitrate	"	£24	..
a " White Sugar	"	£22 15	..
a " Peroxide	"	£33	..
a Methylated Spirit	per gal.	2/6	..
a Potassium, Bichromate, n casks	per lb.	3½d.	..
a Potash, Caustic (75/80 %) ..	per ton	£20	..
a " Chlorate	per lb.	3½d.	..
a " Perchlorate	"	4½d.	..
a Potassium, Cyanide	"	7d.	..
a Shellac	per cwt.	65/-	10/- dec.
a Sulphate of Magnesia	per ton	£4 10	..
a Sulphur, Sublimed Flowers ..	"	£6 10	..
a " Recovered	"	£5 10	..
a " Lump	"	£5 5	..
a Soda, Caustic (white 70 %) ..	"	£11	..
a " Chlorate	per lb.	3½d.	..
a " Crystals	per ton	£5 5	..
a Sodium Bichromate, casks ..	per lb.	3d.	..
a " Cyanide (basis 100 %) ..	"	7d.	..
METALS, &c.			
b Aluminium Ingots, in ton lots ..	per ton	£70	..
b " Wire, in ton lots ..	"	£102	..
b " Sheet, in ton lots ..	"	£120	..
p Babbitt's metal ingots	"	£88 to £145	..
c Brass (rolled metal 2" to 12" basis	per lb.	7½d.	..
c " Tube (brazed)	"	8½d.	..
c " " (solid drawn)	"	7d.	..
c " Wire, basis	"	8½d.	..
c Copper Tubes (brazed)	"	9½d.	..
c " " (solid drawn	"	8½d.	..
g " Bars (best selected) ..	per ton	£71	..
g " Sheet	"	£71	..
g " Rod	"	£71	..
e " (Electrolytic) Bars ..	"	£58 10	..
e " " Sheets ..	"	£74 10	..
e " " Rod	"	£61 10	..
e " " H.C. Wire	per lb.	7¾d.	..
f Ebonite Rod	"	5/8	..
f " Sheet	"	4/9	..
a German Silver Wire	"	1/11	..
h Gutta-percha, fine	"	8/6	..
h India-rubber, Para fine	"	4/10	3½d. inc.
i Iron Pig (Cleveland warrants) ..	per ton	47/-	3½d. dec.
j " Wire, galv. No. 8, P.O. qual.	"	£14	..
g Lead, English Pig	"	£14 10 to £14 12 6	2/6 inc.
m Manganin Wire No. 28	per lb.	6/6	..
g Mercury	per bot.	£9	..
d Mica (in original cases) small ..	per lb.	6d. to 2s.	..
d " " " medium	"	2/6 to 4/-	..
d " " " large ..	"	4/6 to 8/6	..
p Phosphor Bronze, plain castings	"	11d.	..
p " " rolled bars & rods	"	1/0½	..
p " " rolled strip & sheet	"	1/1	..
c Platinum	per oz.	172/6	..
e Silicium Bronze Wire	per lb.	8½d.	..
r Steel Magnet, in bars	per ton	£55	..
g Tin, Block (English)	"	£192 to £193	£2 inc.
a " Wire, Nos. 1 to 16	per lb.	2/1	..
p White Anti-friction Metals ..	per ton	£15 to £150	..
k Zinc, Sh's (Vieille Montagne bnd.)	"	£33	15/- inc.

Quotations supplied by—

a G. Boor & Co.
b The British Aluminium Co., Ltd.
c Thos. Bolton & Sons, Ltd.
d F. Wiggins & Sons.
e Frederick Smith & Co.
f India-Rubber, Gutta-Percha and Telegraph Works Co., Ltd.
g James & Shakspeare.
h Edward Till & Co.
i Bolling & Lowe.
k Morris Ashby, Ltd.
l Richard Johnson & Nephew, L
m W. T. Glover & Co., Ltd.
n P. Ormiston & Sons.
o Johnson, Matthey & Co., Ltd.
p
r W. F. Dennis & Co.

Stewarts & Lloyds, Ltd.—The directors have declared an interim dividend for the half-year to June 30th at the rate of 6 per cent. per annum on the preference shares and 10 per cent. per annum on the preferred ordinary shares.

STOCKS AND SHARES.

Tuesday Evening.

It cannot be pretended that Stock Exchange markets are in anything like a happy state of mind even yet. One thing and another seem to conspire against the peace of prices, so that holders of securities may well be excused for thinking that there is no end to the mal-influences which cause continual depression in their capital. Fortunately so many people are still away making holiday, when prices cease from troubling and holders are at rest, that they are spared the unpleasant sensation of seeing values decline day by day. Some time, no doubt, there will be an end to the incessant liquidation of weak accounts, which lies at the root of much of the trouble, and, with the opening of a new month, hope always springs as eternal as too often it proves to be unfounded.

Quotations, however, have got down on to a level at which some of them certainly look low enough, and it may well be that the autumn will provide better markets than have prevailed during the past quarter. The next thing we suppose that the Stock Exchange will begin to worry about is the rise in the Bank rate usual in September or October, although this is an occurrence so regular that it should not have any effect even upon gilt-edged securities.

The Home Railway Market is still troubled by sales, obviously due to the closing of stock by people who have not sufficient means to go on paying further losses. Moreover, the various obstacles that have arisen in connection with a full settlement of the railway strike are considered quite strong enough pegs upon which to hang further falls. Consequently there are declines of ¾ in Metropolitan Consolidated and 1½ in District Ordinary stocks. Even surplus lands has gone down to the extent of a point, while Brighton Deferred has suffered a very sharp drop. The leading companies have lost traffic, a good part of which will certainly not be recovered, and there is an idea that dividend declarations in respect of the current half-year will not be so rosy as seemed likely a couple of months ago. Underground Electric income bonds, however, picked up part of the loss of last week, while Central London Deferred rose to 50 middle upon a little investment demand.

Amongst the tramway descriptions, Isle of Thanet Preference have moved up to 2⅝ on the assumption that the company is getting nearer the time when it may be able to pay the full dividend on these shares. The weekly traffics show a steady improvement which favours this theory, and although it may be some time before 5 per cent. is distributed, the present buyers are looking forward to the time when this shall take place. Meanwhile, it may be noticed that the 4 per cent. Debenture stock stands at 80, at which the yield is around 5 per cent. on the money, and the improvement in the price of the Preference should, of course, be reflected in the price of the Debenture stock. London United Tramways 4 per cent. Debentures dropped back 2, and British Electric Traction Ordinary fell ½. In Hammersmith and Chiswick, at all events, there is a general expectation that the London County Council will shortly take over part of the London United's lines, but this does not necessarily afford much consolation to shareholders in the company.

In the foreign group there are a few small rises, mostly concerned with the prior-charge stocks of the leading companies. The common shares are mostly a little duller. For example, Mexico Trams are a point lower, and Rio Trams fell ½, which was afterwards regained. Manaos Debentures dropped 2. On the other hand, Perth Electric Tramways Ordinary hardened ⅛ on the better showing which the company makes, and a rise of ⅛ has been secured by Brisbane Tram Ordinary shares.

Mexican descriptions, on the whole, are a little easier. Mexican Light and Power Preferred fell 2, and the First Mortgage Debenture Bonds 1½, while Mexican Electric Light Bonds are 1½ down. The vagaries of Northern Light and Power Bonds have been somewhat arrested this week, and the price at 40 shows a point loss. Shawinigan Water is again lower, and Canadian General Common fell 1.

The feature amongst manufacturing shares is the steady rise in some of the better-class issues. Indiarubber shares gained 10s. Henley's Preference and Callender's Preference are both ⅛ higher, nor is it easy to buy such investments as these except at very nearly the top prices quoted. British Westinghouse Preference moved down to 7s. 6d., and Electric Construction Ordinary are also easier at 14s. 4½d. In both cases there have been sellers of small lots, and these being offered were quite enough to depress the market. Rubber shares are strong, and general opinion looks for the price of the commodity to go over 5s. per lb. in the near future. It is, of course, quite close to this price now, but there will be a heavy offering at Mincing Lane next week, and considerable interest attaches to the way in which the auction sales at Mincing Lane will pass off next Tuesday.

Marconi's attract most of the attention which is being devoted to the telegraph and telephone market. Like other shares in which there is a fairly large speculative account open, they gave way a little, but the fall was a mere trifle compared with the big advance they recently enjoyed, and the price soon shook off its weakness. Anglo-American Deferred have been swayed by the movements of American Railways, in which there was a severe slump, followed by a partial recovery during the past few days. On balance the stock is ½ lower, while the Ordinary and Preferred hardened. In spite of that American slump, however, Mackay Companies Preference put on another 1½ points, making a rise of 4 within a fortnight. West India and Panama shares are a trifle lower, and Western Telegraphs fell ½, although the company's Debenture stock again rose 10s.

Of the Trust Companies, Globe Ordinary shed ½ on sales said to be for speculators who had to realise investments in order to pay for losses incurred in other markets. Submarine Certificates put on ½.

National Telephone Third Preference are a trifle easier, the Preferred and Deferred stocks remaining unchanged. Both Debenture issues are ½ higher. Oriental Preference rose ⅛, while United River Plate Telephone lost a similar fraction.

In the English Electricity Supply market business is extremely quiet. Newcastle Ordinary and Preference have been moved up ½ to bring the prices into line with those prevailing in the North. Urban Preference went back ½, but the company's 4½ per cent. Debenture stock hardened a little, and St. James' 3½ per cent. Debenture moved in the same direction. Amongst the Metropolitan Company's Ordinary and Preference shares there is not a solitary change to record

SHARE LIST OF ELECTRICAL COMPANIES.

ENGLISH ELECTRICITY SUPPLY AND POWER COMPANIES.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations August 29th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bournemouth & Poole, Ord.	10	5½	5½	7⅞ — 8⅛ xd	..	6 5 9
Do. 4½ % Pref.	10	4½	4½	8¼ — 9⅛ xd	..	4 12 4
Do. Second 6 % Pref.	10	6	6	10 — 10⅜ xd	..	5 14 3
Do. 4½ % Deb. Stock	Stock	4½	4½	101 —103	..	4 7 5
Brompton & Kensington, Ord.	5	10	10	7⅜ — 8⅛ xd	..	6 1 3
Do. 7 % Cum. Pref.	5	7	7	7⅜ — 7⅝ xd	..	4 7 6
Central Electric Supply, 4 % Guar. Deb.	100	4	4	98 —101	..	3 19 3
Charing Cross, West End & City	5	5	5	3½ — 4½ xd	..	5 19 2
Do. 4½ % Cum. Pref.	5	4½	4½	4½ — 5 xd	..	4 10 0
Do. "City Undertaking" 4½ % Cum. Pref.	5	4½	4½	3⅝ — 4½	..	5 5 11
Do. Do. 4 % Deb.	100	4	4	94 — 98	..	4 1 8
Chelsea, Ord.	5	4½	5	4 — 4½	..	5 11 1
Do. 4½ % Deb.	Stock	4½	4½	98 —100	..	4 10 0
City of London, Ord.	10	7	7	12½ — 13⅜	..	5 9 10
Do. 6 % Cum. Pref.	10	6	6	12 — 13	..	4 10 0
Do. 5 % Deb.	Stock	5	5	119 —123	..	4 1 4
Do. 4½ % Second Deb.	100	4½	4½	100 —103	..	4 7 5
County of Durham, 5 % First Mort. Deb.	Stock	5	5	89½ — 91½	..	5 9 3
County of London, Ord.	10	5	5	7⅜ — 7⅞	..	6 7 0
Do. 6 % Pref.	10	6	6	11 — 11½	..	5 4 4
Do. 4½ % Deb.	Stock	4½	4½	108 —110	..	4 1 10
Do. 4½ % Second Deb.	Stock	4½	4½	100 —103	..	4 7 5
Edmundson's, Ord.	5	Nil	Nil	⅛ — ¼	..	Nil
Do. 6 % Cum. Pref.	5	Nil	Nil	2⅛ — 2⅜	..	Nil
Do. 4½ % First Mort. Deb.	100	4½	4½	83 — 86	—1	5 4 8
Folkestone	5	5½	6	4½ — 5	..	6 0 0
Do. 5 % Cum. Pref.	5	5	5	4½ — 5½	..	4 15 3
Do. 4½ % First Deb.	100	4½	4½	95 — 98	..	4 11 10
Hove	5	8½	9	6⅞ — 7⅜	+ ⅛	6 2 0
Kensington & Knightsbridge, Ord	5	8	9	6⅜ — 7⅛	..	6 0 0
Do. 4 % Deb.	Stock	4	4	91 — 93	..	4 6 0
Kent Elec. Power, 4½ % Deb.	Stock	4½	4½	80 — 84	..	5 7 2
London Electric, Ord.	3	2	2	1⅝ — 2	..	3 0 0
Do. 6 % Pref.	5	6	6	4⅝ — 5	..	6 0 0
Do. 4 % First Mort. Deb.	Stock	4	4	89 — 92	..	4 7 0
Metropolitan	5	5	5	3⅞ — 4¼ xd	..	5 17 8
Do. 4½ % Cum. Pref.	5	4½	4½	4¼ — 4⅜	..	4 14 9
Do. 4½ % First Mort. Deb.	Stock	4½	4½	100 —105	..	4 5 9
Do. 3½ % Mort. Deb.	Stock	3½	3½	84½ — 87½	..	4 0 0
Midland Electric Corporation 4½ % First Mort. Deb.	100	4½	4½	96½ — 98½	..	4 11 5
Newcastle-on-Tyne	5	4	4	3¾ — 4	+ ⅛	5 0 0
Do. 5 % Pref., Non. Cum.	5	5	5	4 — 4⅛	+ ⅛	5 11 1
North Metropolitan Power Supply, 5 % Mortgages (Red.)	100	5	5	101 — 104	..	4 16 2
Notting Hill	10	7½	8	..	..	..
Oxford	5	7	7½	6¼ — 6⅝	..	5 9 5
St. James' and Pall Mall, Ord.	5	10	10	8½ — 9½	..	5 8 1
Do. 7 % Pref.	5	7	7	6½ — 7½	..	4 16 7
Do. 3½ % Deb.	100	3½	3½	85 — 87	+ ½	4 0 6
Smithfield Markets, Ord.	5	Nil	Nil	1⅜ — 1⅞	..	Nil
South London, Ord.	4	5	5	2⅜ — 3	..	6 13 4
Do. 5 % First Mort. Deb.	100	5	5	98½ — 101½	..	4 18 6
South Metropolitan, 7 % Pref.	1	7	7	1⅛ — 1⅜	..	5 12 0
Do. 4½ % First Deb. Stock	100	4½	4½	97 —100	..	4 10 0
Urban, Ord.	5	5	5	¾ — 1	..	..
Do. 5 % Cum. Pref.	5	5	5	2⅛ — 2⅜	— ⅛	..
Do. 4½ % First Mort. Deb.	100	4½	4½	87½ — 89½	+ ½	5 0 7
Westminster, Ord.	5	10	10	7⅛ — 8 xd	..	6 5 0
Do. 4½ % Cum. Pref.	5	4½	4½	5 — 5⅛	..	4 3 9

COLONIAL AND FOREIGN ELECTRICITY SUPPLY AND POWER.

Adelaide, 6 % Pref.	5	6	6	5⅛ — 5⅜	..	5 4 4
Calcutta, Ord.	5	8	8½	6⅞ — 7⅛	..	5 19 4
Do. 5 % Pref.	5	5	5	4⅞ — 5⅛	..	4 13 0
Calgary Power, 1st Mort. Bds.	100	5	5	90 — 98	..	5 2 0
Canadian Gen. El. Com.	$100	7	7	108 —113	—1	6 3 11
Do. 7 % Pref.	$100	7	7	121 —125	..	5 12 0
Cordoba Lt., Power and T., Ord.	1	2	3	¾ — ⅞	..	3 8 4
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Elec. Lt. and P. of Cochabamba, 6 % Bonds	100	..	6	94 — 96	..	6 5 0
Elec. Supply Victoria, 5 % 1st Mort. Deb.	100	5	5	84½ — 87½	..	5 14 3
Elec. Dev. Ontario, 5 % 1st Mort. Bonds	$500	5	5	88 — 90	..	5 11 1
Kalgoorlie Elec. P. and L., Ord.	10/-	Nil	Nil	1/16 — 3/32	..	..
Do. 6 % Pref.	1	6	6	13/32 — 15/32	..	8 6 8
Kaministiquia Power, 5 % G. Bs.	$500	5	5	101 —103	..	4 17 1
Madras, Ord.	5	Nil	..	2⅞ — 3⅛	..	..
Melbourne, 5 % 1st Mort. Deb.	100	5	5	95 — 97	..	5 3 1
Mexican El. Lt., 5 % 1st M. Bds.	..	5	5	88⅜ — 89¾	— ⅜	5 11 5
Mexican Lt. & Power, Common	$100	4	4	87 — 89	—1	4 9 11
Do. 7 % Cum. Pref.	$100	7	7	108 —110	—2	6 7 3
Do. 5 % 1st Mort. Gold Bds.	..	5	5	96 — 98	— ½	5 2 0
Monterey Rly. Light & Power, 5 % 1st Mort. Deb.	100	5	5	89 — 91	..	5 9 11
Montreal, Lt., H. and Power	$100	6	7	165 —170	..	4 2 4
Northern, Lt., Power and Coal, 5 % 1st Mort. Bonds	$500	5	5	39 — 41	—1	12 3 10
River Plate, Ord.	Stock	9	10	218 —228	..	4 7 9
Do. 6 % Non-Cum. Pref.	Do.	6	6	107 —114	..	5 5 3
Do. 5 % Deb. Stock	Do.	5	5	101½ — 103½	..	4 16 7
Roy. Elec. Co., Montreal, 4½ % 1st Mort. Deb.	100	4½	4½	100 —102	..	4 8 3
Shawinigan Water, Capital	$100	4	4	114 —116	—1	3 0 9
Do. 5 % Con. 1st Mort. Bonds	$500	5	5	107 —109	..	4 11 9
Do. 4½ % Per. Deb.	Stock	4½	4½	103 —105	..	4 5 9
Toronto Power, 4½ % Deb.	Do.	4½	4½	99 —101	..	4 9 1
Vera Cruz Lt., P. and T., 5 % 1st Mort. Deb.	100	5	5	92 — 94	..	5 6 5
Victoria Falls Power, Pref.	1	Nil	Nil	29/32 — 31/32	..	..
West Kootenay Power and Lt., 1st Mort. 6 % Gold	100	..	6	108 —110	..	5 9 1

TELEGRAPH AND TELEPHONE COMPANIES.

Amazon Telegraph	10	Nil	Nil	7⅜ — 7⅝	..	Nil.
Do. 5 % Deb. Red.	Stock	5	5	98½ — 100½	..	4 19 6
American Telep. & Teleg., Cap.	$100	8	8	136 —138	—1	5 15 11
Do. Collat. Trust	$1000	4	4	94 — 96	..	4 3 4
Anglo-American Telegraph	Stock	3⅝	3⅝	67⅜ — 69¼	+ ⅛	5 7 11
Do. 6 % Pref.	Do.	6	6	111⅝ — 112⅝	+ ⅛	5 6 5
Do. Def.	Do.	25/-	30/-	25⅛ — 25⅝	— ⅛	5 17 8
Anglo-Portuguese Tel., 5 % Mort. Deb.	100	5	5	101½ — 103½	..	4 16 7
Chili Telephone	5	8	7	6⅛ — 7⅜	..	4 18 3
Commercial Cable, Stlg. 4 % Deb.	Stock	4	4	87½ — 89½	..	4 9 5
Cuba Telegraph	10	6	6	10⅛ — 11	..	5 9 1
Do. 10 % Pref.	10	10	10	17⅜ — 18¼	..	5 9 7
Direct Spanish Telegraph, Ord.	5	4	4	3⅞ — 4	..	5 0 0
Do. 10 % Cum. Pref.	5	10	10	8⅜ — 8⅝	..	5 14 3
Do. 4½ % Debs.	50	4½	4½	100 —102	..	4 8 3
Direct United States Cable	10	4½	4½	7⅝ — 8⅜	— ⅛	5 7 5
Direct W. India Cable, 4½ % Reg. Deb.	100	4½	4½	99 —101	..	4 9 1
Eastern Telegraph, Ord. Stock	Stock	7	7	136 —139	..	5 0 9
Do. 8½ % Pref. Stock	Do.	8½	8½	84 — 86	..	4 1 5
Do. 4 % Mort. Deb.	Do.	4	4	102 —104	..	3 16 11
Eastern Extension	10	7	7	13½ — 14	+ ⅛	5 0 0
Do. 4 % Deb.	Stock	4	4	100½ — 102½	..	3 18 1
East and S. Africa Tel. 4 % Mt. Db. Mauritius Sub.	25	4	4	100 —102	..	3 18 5
Globe Telegraph and Trust	10	5⅞	5⅞	10⅞ — 11⅛	..	5 4 5
Do. 6 % Pref.	10	6	6	13 — 13⅜	..	4 8 11
Great Northern Telegraph	10	18	18	31 — 32	..	5 12 6
Indo-European Telegraph	25	13	13	56½ — 58½	..	5 11 1
Mackay Companies Common	$100	4	5	86 — 88	..	5 13 8
Do. 4 % Cum. Pref.	$100	4	4	76 — 78	+1½	5 2 7
Marconi's Wireless Telegraph	1	Nil	Nil	2 7/16 — 2 7/16	+ 1/16	..
Monte Video Telephone, Ord.	1	6	6	7/16 — 1	..	6 0 0
Do. 5 % Pref.	1	5	5	3/16 — 7/16	..	5 10 4
National Telephone, Pref.	Stock	6	6	104 —106	..	5 18 2
Do. Def.	Do.	6	6	117½ — 120½	..	4 13 7
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 6 % Cum. 2nd Pref.	10	6	6	10 — 10⅜	..	5 11 7
Do. 5 % Non-cum. 3rd Pref.	5	5	5	5/16 — 5/8	— ⅛	4 8 11
Do. 3½ % Deb.	Stock	3½	3½	98½ — 100½	+ ½	3 9 8
Do. 4 % Deb.	Do	4	4	98½ — 100½	+ ½	3 19 7
New York Telep., 4½ % Gen. Bnds.	100	4½	4½	102½ — 103½	..	4 7 0
Oriental Telep. and Elec.	1	8	8	1 7/16 — 1 1/2	..	4 8 3
Do. 6 % Cum. Pref.	1	6	6	1 7/16 — 1 7/16	+ 1/16	4 11 5
Do. 4 % Red. Deb.	Stock	4	4	88 — 90	..	4 8 11
Pacific and European Tel., 4 % Guar. Debs.	Do.	4	4	99½ — 101½	..	3 18 10
Reuter's	8	5	5	8⅜ — 9⅛	..	4 7 9
Submarine Cables Trust	Cert.	6	6	132 —135	+ ½	4 8 11
Telephone Co. of Egypt, 4½ % Deb. Red.	Stock	4½	4½	99 —101	..	4 9 1
United River Plate Telephone	5	8	8	7⅛ — 7⅜	— 1/16	5 6 8
Do. 5 % Cum. Pref.	5	5	5	5⅛ — 5⅜	..	4 10 11
West Coast of America	2½	2½	2½	1⅜ — 1⅝	..	6 5 0
Do. 4 % Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	4	4	98 —100	..	4 0 0
West India and Panama Teleg.	10	Nil	¾	2 5/8 — 2 13/16	— 1/16	2 13 4
Do. 6 % Cum. 1st Pref.	10	6	6	10 — 10⅜	..	5 12 11
Do. 6 % Cum. 2nd Pref.	10	14½	8	9⅛ — 10⅛	..	5 17 1
Do. 5 % Debs.	100	5	5	101 —103	..	4 17 1
Western Telegraph, Ltd.	10	7	7	13⅛ — 14	— ⅛	5 0 0
Do. 4 % Deb.	Stock	4	4	101 —103	+ ½	3 17 8
Western Union Tel., 4 % Bnds. A	$1000	4	4	107 —110	..	3 12 9
Do. 4½ % Fdg. Bonds	$1000	4½	4½	101 —104	..	4 6 7

* Unless otherwise stated, all shares are fully paid.

Continued on next page.

SHARE LIST OF ELECTRICAL COMPANIES.—(*Continued.*)

ELECTRIC RAILWAYS AND TRAMWAYS.—HOME.

NAME.	Stock or Share.	Dividends for 1909.	Dividends for 1910.	Closing Quotations August 29th.	Rise + or Fall —	Present Yield p.c. £ s. d.
Bath Trams, Pref. Ord.	1	Nil	Nil	¼ — ⅝	..	Nil
Do. 5 % Pref.	1	5	5	⅝ — ¾	..	6 13 4
Do. 4½ % Deb.	100	4½	4½	79 — 88	..	5 8 5
Brit. Elec. Trac., Ord.	10	Nil	Nil	⅜ — 1½	— ⅛	Nil
Do. 6 % Pref.	10	1½	1½	3¾ — 4	..	3 15 0
Do. 5 % Deb.	100	5	5	94 — 97	..	5 3 1
Do. 4½ % 2nd Deb.	100	4½	4½	75 — 79	..	5 13 11
Central London Railway, Ord.	100	3	3	67 — 69 xd	..	4 6 11
Do. Pref.	100	4	4	85 — 87 xd	..	4 12 0
Do. Def.	100	2	2	49 — 51	+1	3 18 5
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 11
City & South London, Ord.	100	1½	1½	29½ — 30½	..	4 18 4
Do. 5 % Pref., 1891	100	5	5	108 —110	..	4 11 0
Do. Do. 1896	100	5	5	104 —106	..	4 14 4
Do. Do. 1901	100	5	5	103 —105	..	4 15 3
Do. Do. 1908	100	5	5	102 —104	..	4 16 2
Do. 4 % Deb.	100	4	4	102 —104	..	3 16 7
Dublin United Trams, 6 % Pref.	10	6	6	12 — 13 xd	..	4 12 4
Great Northern & City, Pr'f. Ord	10	Nil	Nil	⅞ — 1⅛	..	Nil
Hastings Trams, 6 % Pref.	5	Nil	Nil	.. — ..	..	Nil
Do. 4½ % Deb.	100	4½	4½	75 — 80	..	5 12 6
Isle of Thanet Trams, 5 % Pref.	5	1½	2½	2½ — 3	+ ¼	4 3 4
Do. 4 % Deb.	100	4	4	77 — 82	..	4 17 7
Lancashire United, 5 % Deb.	100	5	5	79 — 83	..	6 1 11
London Elec. Railw'ys, 4 % Deb.	100	4	4	96 — 98	..	4 1 8
London United Trams, 5 % Pref.	10	Nil	Nil	3½ — 3¾	..	Nil
Do. 4 % Deb.	100	4	4	70 — 75	—2	5 6 8
Metropolitan Railway Consol.	100	1	1⅝	44½ — 45	— ¾	3 1 1
Do. Surplus Lands	100	2⅜	2⅜	65 — 67	—1	4 2 1
Do. 3½ % Deb.	100	3½	3½	92 — 4	..	3 14 6
Do. 3½ % Pref.	100	3½	3½	88 — 90	..	3 17 9
Do. 3½ % Con. Pref.	100	3½	3½	87 — 89	..	3 18 8
Metropolitan District Ord.	100	Nil	Nil	24½ — 25½	—1½	Nil
Do. 6 % Deb.	100	6	6	145 —147	..	4 1 8
Do. 4 % Deb.	100	4	4	96 — 98	..	4 1 8
Do. 4 % Prior Lien	100	4	4	100 —102	..	3 18 6
Do. 4½ % First Pref.	100	Nil	3½	86 — 88	..	3 13 10
Do. 3½ % Gtd.	100	3½	3½	74 — 76	..	4 9 9
Metropolitan Elec. Trams, Ord.	1	5	5½	3⅞ — 4⅛	..	5 6 8
Do. Def.	1	Nil	Nil	⅛ — ⅜	..	Nil
Do. 5 % Pref.	1	5	5	⅜ — 1 xd	..	5 0 0
Do. 4½ % Deb.	100	4½	4½	99 —101	..	4 9 1
Do. 5 % Deb.	100	5	5	102½—104½	..	4 15 8
Potteries, Ord.	1	2	2	3¾ — 4¼	..	..
Do. 5 % Pref.	1	5	5	3¾ — 3½ xd	..	7 12 4
Do. 4½ % Deb.	100	4½	4½	88 — 91	..	5 18 11
South Metro. Trams, 6 % Pref.	1	3	6	1⅜ — 1⅝	..	10 3 0
Do. 4 % Deb.	100	4	4	73 — 78	..	5 15 5
Underground Elec. Railways 5 % Prior Lien	..	5	5	100½—101½	..	4 18 6
Do. 4½ % Bonds	100	4½	4½	98 —100	..	4 10 0
Do. 6 % Income	100	Nil	1	60 — 62	+1	1 12 3
Do. Power House Debs.	100	..	4	101 —103	..	3 17 8
Yorkshire (West Riding), Ord.	5	Nil	Nil	⅛ — ¼	..	Nil
Do. 6 % Pref.	5	Nil	Nil	2⅜ — 2⅝	..	Nil
Do. 4½ % Deb.	100	4½	4½	80 — 85	..	5 5 11

ELECTRICAL RAILWAYS AND TRAMWAYS.—COLONIAL AND FOREIGN.

Anglo-Arg. Trams, 1st Pref.	5	5	5	5⅛ — 5⅜	..	5 3 6
Do. 2nd Pref.	5	5	5	4⅞ — 5	..	5 0 0
Do. 4 % Deb.	100	4	4	94 — 96	..	4 8 4
Do. 4½ % Deb.	100	4½	4½	101 —103	+1	4 7 5
Do. 5 % Deb.	100	5	5	100½—102½	+ ½	4 17 7
Auckland Trams, 5 % Deb.	100	5	5	102 —105	..	4 16 2
Bombay Elec. S. & Trams, Pref.	10	6	6	10⅜ — 11½	..	5 6 8
Do. 4½ % Deb.	100	4½	4½	96½ — 98½	..	4 11 5
Do. 5 % 2nd Deb.	100	5	5	97 — 99	..	5 1 0
Brisbane Trams Invt., Ord.	5	8	8	6⅜ — 7⅛	+ ⅛	5 12 3
Do. 5 % Pref.	5	5	5	5 — 5⅜	..	4 13 0
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
B. Columbia Elec. Rly., Def.	100	8	8	139 —143	..	5 11 11
Do. Pref. Ord.	100	6	6	119 —123	..	4 17 7
Do. 5 % Pref.	100	5	5	106 —109	..	4 11 9
Do. 4½ % 1st Mort. Deb.	40	4½	4½	100 —103	..	4 7 5
Do. 4½ % Vancouver Deb.	100	4½	4½	101 —104	..	4 6 7
Do. 4½ % Con. Deb.	100	4½	4½	103 —105	+ ½	4 5 9
Calcutta Trams, Ord.	5	4½	6	5⅜ — 6⅛	..	4 16 0
Do. 5 % Pref.	5	5	5	5 — 5⅛	..	4 15 8
Do. 4½ % Deb.	100	4½	4½	102 —105	..	4 5 9
Cape Electric Trams	1	Nil	Nil	⅛ — ⅜	..	Nil
City Buenos Aires Trams (1904)	5	5	5	5⅜ — 5⅝ xd	..	4 12 6
Do. 4 % Deb.	100	5	5	94 — 97	..	5 3 1
Colombo Elec. Tr. & Lt., 5 % Deb.	100	5	5	95 —100	..	5 0 0
Havana Elec. Rly., 5 % Bonds	$1000	5	5	100 —103	+1	4 17 1
Kalgoorlie Elec. Trams	1	Nil	Nil	⅜ — ⅝	..	Nil
Do. 5 % A Deb.	100	5	5	92½ — 95½	..	5 4 9
Do. 6 % B Deb.	100	6	5	63 — 67	..	7 9 3
La Plata Elec. Trms, Prf.	1	6	6	1⅜ — 1⅛	..	5 13 0
Lisbon Elec. Trams, Ord.	1	5½	5½	1 — 1¼	..	4 8 0
Do. 6 % Pref.	1	6	6	1 — 1¼	..	4 16 0
Do. 5 % Deb.	100	5	5	97 —101	..	4 19 0
Madras Elec. Tr. (1904), Deb.	100	5	5	95 — 98	..	5 2 0
Manaos Trams & Lt., 1st Deb.	100	..	5	88 — 91	—2	5 9
Manila Elec. R. and Ltg., Bonds	$1000	5	5	97½ — 99½ xd	..	5 0
Mexico Trams Com.	$100	7	7	119 —121	—1	5 15
Do. Gen. Con. 5 % Bonds	..	5	5	99½—100½	..	4 19 6
Do. 6 % Bonds	100	6	6	98½—100½	— ½	5 16 8
Para Elec. Rlys. & Lt., Ord.	5	..	10	7⅜ — 7½	..	6 13 4
Do. 6 % Pref.	5	6	6	5½ — 5⅝	..	5 4 4
Do. 5 % 1st Deb.	100	5	5	99½—101½	..	4 18 6
Perth (W.A.) Elec. Tr., Ord.	1	2½	..	⅜ — 1	+ ⅛	..
Do. 5 % 1st. Deb.	100	5	5	101½—103½	..	4 16 7
Rangoon El. Tr. & Sup., Pref.	5	6	6	5⅜ — 5⅝	..	5 6 8
Do. 4½ % 1st Deb.	100	4½	4½	98 —101	..	4 9 1
Rio de Janeiro Trams	$100	1	4½	115½—116½	— ½	3 17 3
Do. 1st Mort. 5 % Bonds	..	5	5	101½—102½	..	4 17 10
Do. 5 % Mort. Bonds	100	5	5	97½ — 98½	..	5 1 0
Sao Paulo Tram, Lt. and P.	$100	10	10	178 —181	..	5 10 6
Do. 5 % 1st Deb.	$500	5	5	103 —105	..	4 15 3
Singapore Trams, 5 % Deb.	100	5	5	83 — 87	..	5 15 0
Southern El. Tr. B.A., 5 % Deb.	100	5	5	95 — 98	..	5 2 0
Un. Elec. Trams Monte Video	5	5	6	5½ — 6	..	5 0 0
Do. 6 % Pref.	5	6	6	5 — 5½	..	5 9 1
Do. 5 % 1st Deb.	100	5	5	102 —105	..	4 15 3
Winnipeg Elec. Rly., 4½ % Deb.	100	4½	4½	107 —109	..	4 2 7

MANUFACTURING COMPANIES.

Aron, Ord.	1	..	Nil	⅛ — ¼	..	Nil
Do. 6 % Pref.	1	12	9	7½ — 7¾	..	7 7 8
Babcock & Wilcox	1	24	26	5⅜ — 5⅝	..	4 12 6
Do. Pref.	1	6	6	1⅜ — 1½	..	4 0 0
B.I. & Helsby Cables	5	10	10	6⅞ — 7⅛	..	6 15 7
Do. Pref.	5	6	6	5⅞ — 6⅛	..	4 16 0
Do. Deb.	100	4½	4½	102 —104	..	4 6 7
British Thomson-Houston, Deb.	100	4½	4½	96 — 99	..	4 10 11
British Westinghouse, Pref.	3	Nil	Nil	⅛ — ⅜	— 1/32	Nil
Do. Deb.	100	4	4	59 — 62	..	6 9 1
Do. 6 % Prior Lien	100	6	6	102 —104	..	5 15 5
Browett, Lindley, Ord.	1	Nil	Nil	1/6—2/-	..	Nil
Do. Pref.	1	Nil	Nil	5/- —6/-	..	Nil
Brush, Ord.	2	Nil	Nil	¼ — ½	..	Nil
Do. 7 % Pref.	2	Nil	Nil	⅜ — ⅝	..	Nil
Do. 4½ % Deb.	100	4½	4½	58 — 63	..	7 2 10
Do. 4½ % Second Deb.	100	4½	4½	39 — 44	..	10 4 6
Callender's Cable	5	15	15	9½ — 9⅝	..	7 15 11
Do. Pref.	5	5	5	4⅛ — 5⅛	+ 1/16	4 16 5
Do. Deb.	100	4½	4½	101 —103	..	4 7 5
Castner-Kellner	1	14	17½	8½ — 9⅝	..	4 17 0
Do. Deb.	100	4½	4½	102 —105	..	4 5 9
Crompton & Co.	3	Nil	Nil	⅛ — ⅜	..	Nil
Do. Deb.	100	5	5	57½ — 67½	..	7 8 2
Dick, Kerr	1	6	5	1⅜ — 1⅝	..	5 6 8
Do. Pref.	1	6	6	1⅜ — 1⅝	..	5 9 7
Do. Deb.	100	4½	4½	95 — 98	..	4 11 10
Edison & Swan, A, £3 paid	5	Nil	Nil	⅝ — 1⅛	..	Nil
Do. fully paid	5	Nil	Nil	1⅜ — 2⅜	..	Nil
Do. 4 % Deb.	100	4	4	67 — 71	..	5 12 8
Do. 5 % Second Deb.	100	5	5	78 — 81	..	6 3 5
Electric Construction	2	Nil	2½	2⅛ — 2⅝	— 1/32	6 8 0
Do. Pref.	2	7	7	1¼ — 1⅜	..	7 4 4
Greenwood & Batley, Pref.	10	7	7	7½ — 8½	..	8 5 8
Do. Deb.	100	5	5	94 — 96	..	5 4 2
General Electric, Pref.	10	5	5	8½ — 9	..	5 11 1
Do. Deb.	100	4	4	88 — 93	..	4 6 0
Henley's, Ord.	5	15	15	12¾ — 12⅞	..	5 16 6
Do. Pref.	5	4½	4½	5 — 5½	+ 1/16	4 5 9
Do. Deb.	100	4½	4½	106½—108½	..	4 2 11
India-Rubber, G. & T.	10	10	10	12 — 14	+ ½	7 2 10
Do. Pref.	10	5	5	9⅞ — 10⅜	..	4 16 5
Telegraph Construction	12	17½	20	34½ — 36½	..	6 11 7
Do. Deb.	100	4	4	100 —102	..	3 18 5
Willans & Robinson	1	Nil	Nil	3/32 — 5/32	..	Nil
Do. Pref.	5	1½	Nil	¾ — 1	..	Nil
Do. Deb.	100	4	4	55 — 65	..	6 3 1

* Unless otherwise stated, all shares are fully paid.

Bank rate of Discount 3 per cent., March 9th, 1911.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING JULY, 1911.

THE July returns of the electrical exports from this country show a falling off in total of some ten thousand pounds in value as compared with those of June. Noticeable decreases occurred in the values of telegraphic, telephonic and cable exports, but, on the other hand, the electrical machinery section improved, reaching a total of over £168,000 for the month. The month's total, however, bears favourable comparison with the monthly returns of 1910, if allowance be made for the extraordinary telegraphic exports which occurred in five months of that year. The import total for July amounted to £188,360, as compared with £183,260 in the previous month, an increase occurring in the telegraphic section, while lamp and machinery imports show a falling off.

The re-exports at £19,791 are some £9,000 lower than in June.

Notable purchasers of British electrical goods were our Australian and South African colonies, while South America, India, Japan and Canada were, as usual, good customers.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports.	Electrical goods and appliances.	Wires and cables, rubber and other insulations.	Electric lighting fittings and accessories.	Electric lamps and parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	481	364	78	216	466	4,446	398	45	...	98	3,076	9,668
Germany	1,485	2,798	24	385	334	563	723	58	...	25	...	6,395
Netherlands and Java	447	1,173	93	86	44	440	...	3	...	...	27	2,313
Belgium	880	642	105	173	113	4,836	43	...	...	857	177	7,826
France	808	38	1,108	13	18	4,266	283	...	...	147	2,362	9,043
Portugal	9	20	35	13	...	101	284	...	...	22	5	489
Spain and Canary Isles	751	...	24	25	51	1,040	...	...	...	...	293	2,184
Switzerland, Italy and Austria-Hungary ...	155	...	172	12	7	3,374	1,619	14	...	77	10	5,440
Greece, Bulgaria, Roumania and Turkey ...	270	23	93	30	...	612	3	60	...	35	10,588	11,714
Channel Isles, Gibraltar, Malta and Cyprus ...	25	46	28	31	181	19	...	3	...	12	447	792
U.S.A., Philippines and Cuba	47	25	15	297	9	4,658	37	...	...	...	2,896	7,984
Canada and Newfoundland	523	5,213	393	946	1,644	6,305	27	286	65	97	38	15,537
British West Indies and British Guiana ...	1	43	26	28	...	...	...	38	10	97	...	243
Mexico and Central America	615	2,866	145	106	12	220	...	...	...	483	...	4,447
Peru and Uruguay	64	11	145	380	27	127	...	20	...	830	14	1,618
Chile	187	451	363	242	66	2,825	...	...	...	62	116	4,312
Brazil	356	1,188	342	347	390	2,420	740	2	...	4,809	7,232	17,826
Argentina	1,169	3,912	597	1,170	754	20,307	692	1,861	162	4,383	2,289	37,296
Colombia, Venezuela and Bolivia	...	...	55	...	...	606	...	...	...	...	...	661
Egypt, Tunis and Persia	607	359	85	...	10	5,376	628	254	28	688	4	8,039
British West Africa	65	429	131	142	9	753	...	307	21	18	259	2,134
Rhodesia, O.R.C. and Transvaal	1,780	795	324	1,865	4	5,310	175	300	21	119	9	10,702
Cape of Good Hope	1,303	903	119	942	360	1,827	40	3,481	44	154	981	10,154
Natal	1,173	6,480	1,036	1,006	16	787	...	174	...	685	15	11,372
Zanzibar, Brit. East Africa, Mauritius & Aden	46	11	46	143	...	25	...	9	11	20	484	795
Azores, Madeira and Portuguese Africa ...	408	273	199	137	24	574	81	10	...	...	57	1,763
French African Colonies and Indo-China ...	16	35	28	72	74	...	...	...	...	...	...	225
China and Siam	430	743	310	106	429	2,170	187	40	...	56	904	5,375
Japan and Korea	251	40	80	44	475	28,710	3,345	210	...	880	42	34,077
India	1,852	8,986	1,920	1,805	488	15,165	2,896	2,728	51	526	150	36,567
Ceylon	99	754	85	157	300	1,214	39	144	...	202	53	3,047
Straits Settlements, Fed. Malay States and British North Borneo	136	661	217	336	100	462	86	109	88	189	726	3,110
Hong Kong	20	213	288	14	204	598	265	22	20	...	...	1,644
West Australia	577	796	52	30	322	757	...	2	...	75	329	2,940
South Australia	605	144	49	20	25	984	...	...	...	313	65	2,205
Victoria	1,404	6,586	145	1,143	641	8,191	...	300	28	9,753	218	28,409
New South Wales	2,125	7,127	825	1,561	675	22,008	2	48	107	617	421	35,516
Queensland	230	103	1,365	326	151	2,242	...	8	...	492	...	4,917
Tasmania	...	139	40	68	93	...	...	33	...	27	...	400
New Zealand	985	1,778	280	816	6	1,590	125	337	...	1,247	302	7,466
Total, £	22,385	56,168	11,465	15,233	8,522	155,908	12,718	10,906	656	28,095	34,589	356,645

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	166	...	67	71	...	2,478	421	402	10	4,319	7,934
Germany	1,469	4,172	1,127	16,823	1,882	50,521	30	1,006	4,493	38,150	119,673
Holland	...	...	120	1,324	...	62	...	...	8	139	1,653
Belgium	374	1,910	3	18	177	3,539	42	688	328	7,154	14,233
France	...	750	707	1,591	538	739	...	615	3,489	2,661	11,090
Switzerland	34	1,771	179	62	...	2,361	60	...	11	540	5,018
Italy	...	184	12	...	...	48	...	...	...	3,026	3,270
Austria-Hungary	...	1,513	458	536	...	185	...	...	246	49	2,987
United States	1,720	44	137	1,049	19	11,516	7,258	112	120	466	22,441
Total, £	3,763	10,344	2,810	21,474	2,616	71,449	7,811	2,823	8,705	56,504	188,299

Additional imports: Canada, goods, £35; Spain, carbons, £26.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above	12,316	1,695	...	1,736	...	4,752	...	145	541	301

TOTAL EXPORTS: £356,645. TOTAL RE-EXPORTS: £19,791. TOTAL IMPORTS: £188,360.

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

REVIEWS.

The Propagation of Electric Currents in Telephone and Telegraph Conductors. By J. A. FLEMING, M.A., D.Sc., F.R.S. London : Constable & Co., Ltd. Price 8s. 6d. net.

In the early part of last year Dr. Fleming delivered a course of lectures at University College on the theory of the transmission of alternating currents, with particular reference to telegraph and telephone working. In view of the importance which transmission questions have assumed during recent years, great interest was taken in these lectures, and when Dr. Fleming, during a course of lectures on electrical measurements, which he delivered at the same institution in the early part of this year, said that he was arranging to have his transmission lectures, and also the course of lectures on which he was then engaged, incorporated in book form, the announcement was received with great satisfaction.

The book has now been published, and it certainly fulfils the hope expressed by the author, that it may serve as a stepping stone to the work of original investigators of a more advanced character.

Up to the present there has been no work in which the student or engineer engaged in telegraph or telephone matters could find, in a single volume, a fairly full account of the modern methods of dealing with transmission problems. It was necessary to refer to numerous detached papers, written by investigators on both sides of the Atlantic, and therefore Dr. Fleming deserves the thanks of the telegraph and telephone engineering profession for the work he has done in collecting the information contained in these scattered papers, and placing it in a readily accessible form.

A knowledge of the use of hyperbolic trigonometry is, unfortunately, not yet very widely spread among electrical engineers, but, since great use is made of this branch of mathematics in modern transmission theory, Dr. Fleming devotes the first chapter of his book to a brief explanation of its fundamental principles. A useful table of hyperbolic functions of imaginary quantities is given at the end of the chapter.

The second chapter deals with the propagation of electric waves along conductors. The reflection phenomena which occur at the ends of a circuit are discussed, and the chapter concludes with an investigation into the attenuation and wave-length constants of a line.

In Chapter III the theory of the propagation of simple periodic currents along a telephone loop is worked out. The three cases of a loop disconnected at the distant end, short-circuited at the distant end, and with the distant end closed through a receiving instrument, are separately considered, and the formulæ giving the current and voltage in different portions of the circuit under these different conditions are obtained.

The fourth chapter deals with the question of the propagation of actual telephonic speech waves over a loop, and discusses the various methods which have been proposed for improving the quality of transmission over a telephone circuit.

In the fifth chapter the theory of the transmission of signals over a submarine cable is worked out, and the method of improving the speed of signalling by means of curb-sending is explained.

Chapter VI deals with the special case of the propagation of high-frequency currents, such as those used in wireless telegraphy, and also with the case of the transmission of currents of very low frequency, or of continuous currents, over leaky lines.

In Chapter VII are given the methods used for actually measuring the constants of cables, in order that the formulæ obtained in the previous chapters may be put to practical use.

The eighth chapter deals with the application to practical cases of the theory previously given, and shows how nearly the results obtained by actual measurement agree with those obtained by calculation.

In the last chapter the methods employed in present-day practice for improving transmission over telephone circuits, aerial, underground, and submarine, are described.

The book concludes with a table of hyperbolic functions of angles from 0 up to 7·5 radians.

It will thus be seen that the subject of transmission has been treated in all its different aspects, and that after working through this book, the student should have a good all-round grasp of, at any rate, the ground work of this branch of applied electricity.

Unfortunately, however, there is a very large number of errors in the book, many of which, we regret to say, do not appear to be ordinary printers' mistakes. The argument is also somewhat obscure in several places. It would appear as if the book had been prepared very hurriedly for the press, and that sufficient care had not been given to the correction of the proofs, so that the slips mentioned have been overlooked. Doubtless, in the subsequent editions which, we think, will certainly be required, the necessary corrections will be made.

In view, however, of the great importance which the subject possesses, and the annoyance which is likely to be caused by these errors to students who are approaching it for the first time, we give below some notes, which we hope will enable the reader to avoid the difficulties with which, perhaps, he would otherwise have been troubled.

Page 18, 9th line—

$$\text{P F} = \sqrt{y^2 + (x - c)^2}$$

should be—

$$\text{P F} = \sqrt{y^2 + (c - x)^2}.$$

The equation as it stands applies to the case when the line F P has turned through an angle greater than a right angle, but, with the figure as shown, the correction mentioned above is necessary.

Page 18, 12th line.—It is suggested that this line read as follows :—

"Accordingly, $\text{P F}' + \text{P F} = \frac{2\,c\,x}{a}$, from equation (3), because $\text{P F}' - \text{P F} = 2\,a$."

Page 20, Equation (10).—The final term in this equation should be—

$$-\int \frac{x^2}{\sqrt{x^2 - a^2}} \cdot d\,x.$$

Page 20, Equation (14).—This should read—

$$\varepsilon^u = \cosh u + \sinh u.$$

Page 22, Equation (20).—The third term should be—

$$+ \frac{u^2}{1.2} - \ldots.$$

Page 22, Equation (21).—The fourth term should be—

$$+ \frac{u^7}{7} + \ldots.$$

Page 24, Line 24.—

$\frac{x}{a}$ cosh u should read $\frac{x}{a} = \cosh u$.

Page 27, Equation (35).—

$$\text{Tanh}\,(a + j\,b) = \frac{\text{Tanh}\,a + j \tanh b}{1 + j \tanh a \tanh b}$$

should read—

$$\text{Tanh}\,(a + j\,b) = \frac{\text{Tanh}\,a + j \tan b}{1 + j \tanh a \tan b}.$$

Page 28, 11th line.—Cosh $a + j\,b$ should read cosh $(a + j\,b)$.

Page 28, 27th line.—The angle should be 85° 56′ 36″, not 89° 7′ 44″.

Page 60, 4th line, and page 61, 5th line.—References are made to "small circles marked with a dot and a cross" on fig. 4, and also to the magnetic flux lines being shown dotted on the same figure. The magnetic lines are shown on the diagram in question full, while it is the lines of electric strain which are shown dotted. Also, the small circles marked as described above do not appear to exist. Such inconsistencies between a diagram and the text are apt to be extremely puzzling to the reader, as Dr. Fleming himself observes on page 129 !

Page 66, 3rd line from end.—"Sending end" should read "receiving end." See last paragraph on page 71.

Page 78, Equation (20).—This equation does not appear to have been previously given in the book, although Dr.

Fleming introduces it as an expression which has already been obtained.

It may, however, be deduced thus :—Rewrite equation (19), changing the sign of x, so as to obtain x measured from the receiving end. Find $\frac{d\,V}{d\,x}$ from this altered equation, and equate it to equation (25), page 68. Then again change the sign of x, so as to get x measured from the sending end. This gives equation (20).

Page 78, Equation (22).—The bracket before cosh P x should be deleted.

Page 79, Equations (24) and (26).—It is not clear, without much further explanation than is given by Dr. Fleming, how these equations can be deduced. The method is as follows :—

Rewrite equation (19), measuring x from the receiving end. We thus get—

$$V = A\,e^{Px} + B\,e^{-Px}.$$

If now distances be measured from the sending end, the x in this equation becomes $(l-x)$ and we get—

$$V = A\,e^{P(l-x)} + B\,e^{-P(l-x)}.$$

Therefore $V = A\,[\cosh P(l-x) + \sinh P(l-x)] +$

$$B\,[\cosh P(l-x) - \sinh P(l-x)].$$

$$V = (A + B)\cosh P(l-x) + (A-B)\sinh P(l-x).$$

In a similar manner we can deduce from equation (20) the following equation—

$$I = \frac{1}{Z_0}[(A-B)\cosh P(l-x) + (A+B)\sinh P(l-x)].$$

When $x = l$ we have $V = V_2$ and $I = I_2$.

This gives $V_2 = A + B$

$$\text{and } I_2 = \frac{A - B}{Z_0}$$

since $\sinh 0 = 0$ and $\cosh 0 = 1$.

$$\text{Hence } A = \frac{V_2 + I_2 Z_0}{2}$$

$$\text{and } B = \frac{V_2 - I_2 Z_0}{2}.$$

Substituting these values for A and B in the equations just obtained for V and I, we get the required equations (24) and (26).

Page 88, Equation (64).—In order to deduce equation (70) a third theorem is required, which can be demonstrated by a method similar to that employed to demonstrate theorem II. The third theorem is as follows :—

$$B\sinh\delta + A\cosh\delta = \sqrt{A^2 - B^2}\cosh(\delta + \gamma)$$

$$\text{where } \tanh\gamma = \frac{A}{B}.$$

Page 124, 25th line.—"0·2 heavy" should read "0·2 henry."

Page 190, 9th line.—Dr. Fleming is deducing an expression for the capacity of a long cylindrical wire of circular section with radius r, length l, and having a charge ρ per unit area. He obtains the value of the potential, and then adds :—

"But, since $Q = 2\pi r\rho l$ is the whole charge on the wire, the capacity $C = \frac{Q}{V}$."

We do not suppose that any reader will be misled into thinking that the equation $C = \frac{Q}{V}$ depends on the fact that $Q = 2\pi r\rho l$, but we quote this as an example of looseness of expression and want of logical sequence which does not tend to smooth the path of the student.

Page 191, Equation (7).—This is the force in the direction O P, not that in the direction P O.

Page 191, Equation (8).—The upper integration limit, ∞, has been omitted.

Page 192, Equations (11) and (12).—Instead of—

$$V_A = (-2q\log r + C) - (-2q\log D + C)$$

equation (11) should read—

$$V_A = (-2q\log r + C) + [-2(-q)\log D + C],$$

also, instead of—

$$V_B = -(-2q\log r + C) + (-2q\log D + C),$$

equation (12) should read—

$$V_B = [-2(-q)\log r + C] + (-2q\log D + C).$$

Page 224, 16th line.—The equation—

$$A = \frac{p\,C\,V}{10^6}$$

should read—

$$A = \frac{n\,C\,V}{10^6}.$$

Page 250, 6th line from bottom.—

$$106^{-6}$$

should be— 10^{-6}.

From the foregoing it will be seen that the errors are by no means few and unimportant, and to a student, who approaches the subject as a new one to himself, may cause considerable perplexity.

PROCEEDINGS OF INSTITUTIONS.

Electric Traction in Switzerland.

By E. Huber-Stockar.

(*Abstract of paper read at the Zurich meeting of the* Institution of Mechanical Engineers, *July*, 1911.)

(*Concluded from page* 292.)

Lötschberg Railway.—The Bern-Lötschberg-Simplon, or B.L.S., is constructing a normal gauge double track railway, which will give the most direct access to the Simplon, and consequently to Italy from the north-western part of Switzerland and the Bernese lake district. It will be of great importance to international passenger and freight traffic, as it considerably shortens the distance of travel between important places.

The new railway is noted for its tunnel across the northern main range of the high Alps. This is 14,536 m. (9 miles) long, or only 463 m. shorter than the St. Gotthard Tunnel. The new railway, still in course of construction and to be opened probably within about two years from now, has a length of 60·4 km. between Frutigen and Brigue, and will resemble the St. Gotthard railway a good deal in general character.

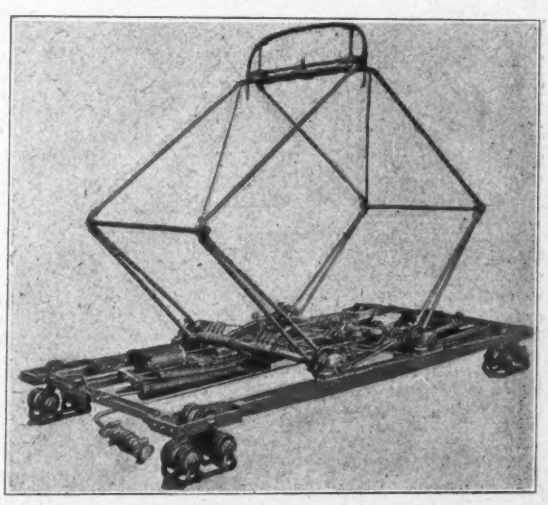


Fig. 14.—Pantograph Collector, Lötschberg Locomotive.

The access to the northern end of the new railway is a line from Spiez, on the Lake of Thun, to Frutigen, 13·4 km. long and operated by steam since 1901. This has been equipped electrically by the B.L.S. After careful consideration, single-phase traction with high voltage (15,000) and low frequency (15) were adopted, and towards the end of 1908 orders were placed with the A.E.G. for one locomotive of 1,600 H.P., with Oerliken and Siemens-Schuckert, jointly for three passenger motor-cars of 450-900 H.P. each, one locomotive of 2,000 H.P. and the equipment of the line. The three motor-car equipments have been made by the Siemens firm., the cars

TABLE III.—Bern-Lotschberg-Simplon Data.

	Motor-cars (3).	2,000-*h.p. locomotive* (1).	1,600-*h.p. locomotive* (1).
Arrangement of axles	Two bogies with two axles each	Two bogies with three axles each	Two half-locomotives, each with two driving and one adjustable pony axle
Total weight	52 tons approx. 64 seats	90 tons	96 tons
Total weight on drivers	30 tons (later on 52 tons)	90 tons, equally distributed	68 tons, 25 tons on pony axles
Weight of electric equipment	21 tons approx.	44 tons	49 tons
Weight of one motor, one transformer	3·8 tons; 4·0 tons	9·8 tons; 5·5 tons	14·0 tons
System of motors and speed control	Series, auxiliary poles, voltage speed, speed control by contactors	Series, auxiliary poles, voltage control by contactors	Repulsion voltage speed control by contactors
Transformers on car	Two of 450 K.V.A.	Two of 1,000 K.V.A., ratio 15,000 : 420	—
Voltage of motors	—	420-0	—
Power of one motor (1 hour rating)	230 H.P.	1,000 H.P.	800 H.P.
Number of motors on vehicle	Two (later on four)	2	2
Mechanical arrangement	Enclosed motor, spring suspended, geared (1 : 3·45) to driving axle	Motor rigid in spring supported bogie truck, high, open, geared (1 : 3·25) to counter crankshaft below, connecting rods	Motor rigid in spring-supported main frame, high, open, connected by almost perpendicular rods in counter crankshaft, connecting rods horizontal
	With four motors.		
Maximum total pull on tread	7,400 kg.	16,000 kg. coefficient of adhesion 1 : 5·3	13,500 kg.
Maximum total pull on hook	6,300 kg.	13,000 kg.	—
Normal speed of vehicle	45 km. per hour	42 km. per hour	40 km. per hour
Normal weight of train without locomotive	—	500 tons on 15·5 per cent.; 310 tons on 27 per cent.	400 tons on 15 per cent. 250 tons on 27 per cent.
Speed maximum	70 km. per hour	70 km. per hour	75 km. per hour
Acceleration.	—	0·05 m. per sec. per sec.	—

by Schlieren, the large locomotive by Oerlikon, and its mechanical part by Winterthur. The mechanical part of the A.E.G.'s locomotive is by Krauss & Co., of Munich.

The electrification of this short line of access, Spiez-Frutigen, was undertaken as an experiment, and in case of success, as a preparation for electric traction on the whole line from Spiez to Brigue, 73·7 km. in all. The success has been such that it will be extended to the whole line and on the same system. For this reason, the Spiez-Frutigen electrification deserves special consideration as being the first section of a main railway, furnishing in certain respects exactly the problem of the St. Gotthard electrification—namely, long heavy grades of 2·7 per cent., and heavy trains requiring 2,000 H.P. and more.

The electric current for the present service on the Spiez-Frutigen line is supplied as single-phase A.C. at 16,000 volts and 15 cycles for use on the motor-car and locomotive equipments.

The overhead contact-line of the Spiez-Frutigen line is of most substantial design, all supports being of steel. The devices for the supply of current to the individual sections of line or railway stations, for protection from lightning, and the electrical apparatus, are nicely housed, in a style, up to the general standard of installation on main railways.

The general data of the motor-cars and locomotives are found in Table III. The brakes of all vehicles are of the Westinghouse type.

The contacts are of the pantograph pattern and are capable of self-adjustment from 4·800 m. to 7·050 m. height.

The large gears of the 2,000-H.P. locomotive are of the N spiral type made by Citroën, of Paris. The pitch circle diameters are 1,453 and 447 mm. They are automatically machine cut, work without noise and vibration, have surfaces much in excess of those of any other type of gear wheels, and run at a circumferential speed of 22 m. per sec. The maximum surface-pressure on the teeth is 260 kg. per sq. cm.

The B.L.S. locomotive of the Oerlikon Co. is near the limit, where the use of gearing affords a decided advantage over connecting rods direct from the motor. The gearing does away with all reciprocating parts within the cabin of the locomotive and makes balancing easy. For low-speed locomotives, especially freight engines, with a large pull on the draw-bar and comparatively little horse-power, the gearing is a decided advantage in many respects and is likely to be commonly adopted. The locomotive built by the A.E.G. for the B.L.S. is of novel design in electric traction on Swiss railways. The motors are placed high in the cabin, with cranks on the motor-shafts, from which motion is transmitted to the horizontal connecting rods of the driving wheel axles, by means of a system of intermediate connecting rods reciprocating up and down. The geared and the gearless type of locomotives will probably have each a more or less defined field of application of its own. There will be a field open to both types, where either will represent more or less a compromise.

In general, with low speed, and more particularly with powerful low-speed locomotives, the adoption of gears permits of more satisfactory design, construction and operation, while, with all high-speed locomotives, the elimination of gears is either advantageous or otherwise desirable. The locomotives of the B.L.S. are neither of high nor low speed. Their maximum power is, however, developed on the up-grades at low speeds, while the higher speeds occur on the down slopes with no load, and on the gentle slopes or levels only with less than full load on the motors. It will be highly interesting and important to compare the two radically different types of locomotives on the B.L.S., where there are reasons for each. The transformers on the vehicles were arranged to permit of working at half contact line voltage, if 15,000 proved impracticable. In fact, at the time when all trains were steam-driven and the electric vehicles were being run for experimental purposes, some flashing over from smoky insulators in the Hondrich Tunnel (1,604 m. long), just behind Spiez, was observed, and a periodical cleaning of the insulators was made. Since steam traction has disappeared no such trouble has been experienced, and it is expected, as the smoke nuisance will not exist on the new line, that the contact-line voltage will not require any reduction. At any rate, the B.L.S. electrification will conclusively prove whether single-phase, high voltage, low periodicity electric traction is the right method for the operation of a railway.

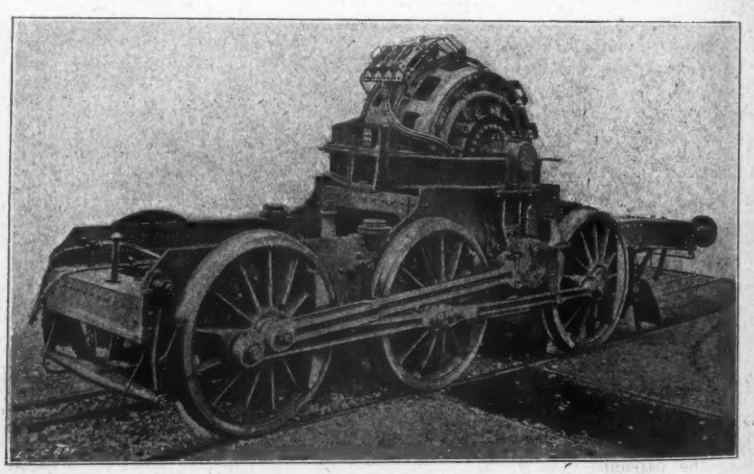


Fig. 15.—Oerlikon 1,000-H.P. Bogie, for Lötschberg 2,000-H.P. Locomotive.

Engadin (Rhätische Bahn).—The company operates about 217 km of line, all in the Kanton Granbündten, and is constructing at the present time a new line from Bevers, in the Upper Engadin, to Schuls, in the Lower Engadin, about 49 km. long.

This new line, together with the sections already existing in the Upper Engadin, will be operated by electricity. Single-phase A.C. of 15 cycles and 10,000 volts has been chosen. The low voltage is justified by the smaller power required on a narrow-gauge railway and by the difficulty which might have been encountered in placing

the contact wires in the restricted space of the numerous and lengthy narrow-gauge tunnels.

The contact line will be overhead, with collectors of the pantograph bow type. It is intended to work exclusively on the locomotive train plan, which is the plan of operation of the remainder of the Rhätische Bahn. The orders for three locomotives of

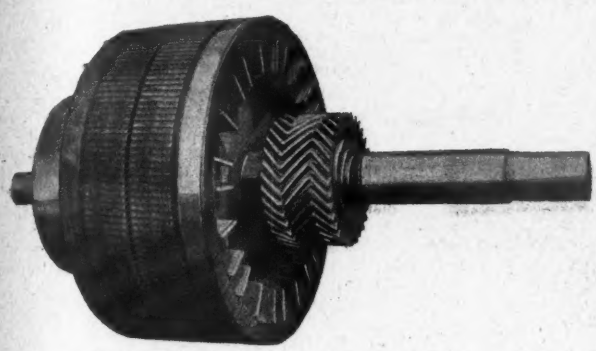


Fig. 16.—Armature and Gear Wheel, Lötschberg Locomotive.

600 H.P. each, for eight of 300 H.P. each, and for the line equipment, have been placed with the following firms—A.E.G., Alioth, Brown-Boveri, Oerlikon and Siemens-Schuckert.

There will be three different patterns of each of the two different types of locomotives. As far as the author is informed, all these locomotives will have motors placed in the cabin above the axles, geared to counter crankshafts, the cranks of which will be connected with the cranks of the driving axles by connecting-rods, the details being arranged in some of the numerous ways possible.

The Schweizerische Studiencommission für electrischen Bahnbetrieb.—This paper would be incomplete if it did not mention, in addition to the electric railways working or building, the work done for years in Switzerland, with a view to elucidating the general railway electrification question under Swiss conditions.

The principal conclusions of the Studiencommission as to systems of electric traction, and more particularly as to unified periodicity of A.C. for electric traction, are exhibited in practice in the series of railways described, beginning with the Seebach-Wettingen experimental line of the past and ending with the Engadin line of the Rhätische Bahn now in course of construction.

holds the record up to now, at the same time adopting speeds and accelerations more or less in excess of those accepted for the hypothetical electric traction of "1904."

Of the figures that follow, those in parentheses refer to the "future." The speeds of express trains are from 85 (90) km. per hour on the level to 40 (50) on 1 in 40 grades. The speeds of passenger trains are 55 (75) to 26 (50), and those of freight trains 38 (45) to 18 (35).

The starting H.P. is limited to 1·25 times the normal H.P. on 1 in 40 grade; acceleration as such is, however, limited to 0·15 (0·20) m/s/s with express, to 0·15 (0·30) m/s/s with passenger and to 0·10 (0·10) m/s/s with freight trains. The weights of the trains will not increase much in the future because of the car couplings (all increase in traffic will be met with faster and more frequent trains); these were in 1904 (maximum in parentheses) actually: with express trains on most sections 200-220 (280-350) tons, with passenger trains 120-180 (240-350), with freight trains on the main line 350-380 (500) and on other sections 270-350 (330-370) tons, all exclusive of locomotives. In fact, freight trains being moved by two eight-wheelers at the head and one at the rear are usual on the slopes. There will be required about 19 (21) motor-cars of 200-500 (400-1,100) H.P., about 9 (15) fast locomotives of 1,800 (2,200) H.P., and about 37 (38) goods locomotives of 800 (1,500) H.P.

Electric single-phase alternating-current, of 15 cycles and 15,000 volts for the supply to sections immediately adjacent, and of perhaps three times as much for transmission to transformer sub-stations supplying the sections remote from the power station, is proposed. There will be 2 (3) power stations required, the most important one situated a little below Airolo, near Ambri-Piotta station, having Lake Ritom as a water-power storage. The power required for traction is considerable and the load line has enormous peaks. The total power developed on the tread of the locomotives on the whole line ("future" figures in parentheses) will amount to about 14,000 (22,000) H.P. maximum and about 5,000 (10,000) on the average. On individual sections the proportion of maximum and average is, however, less favourable. There will be required from the hydraulic turbines 27,000 (46,000) H.P. maximum. There will be installed in 2 (3) power stations, hydro-electric machinery of about 50,000 (95,000) H.P., including stand-by.

The Studiencommission has investigated the application of accumulator batteries for storing power for the local peak loads. It has, however, been found uneconomical, on account of the highly increased expenditure for sub-station machinery, plant, maintenance and operation.

The total cost of new plant, new rolling stock and accessories, alterations on telegraphs, telephones and signals, supervision, interest during construction, all complete, will amount to about 44 (67) millions of francs. These figures give an idea of the magnitude of this electrification which is expected before long. The

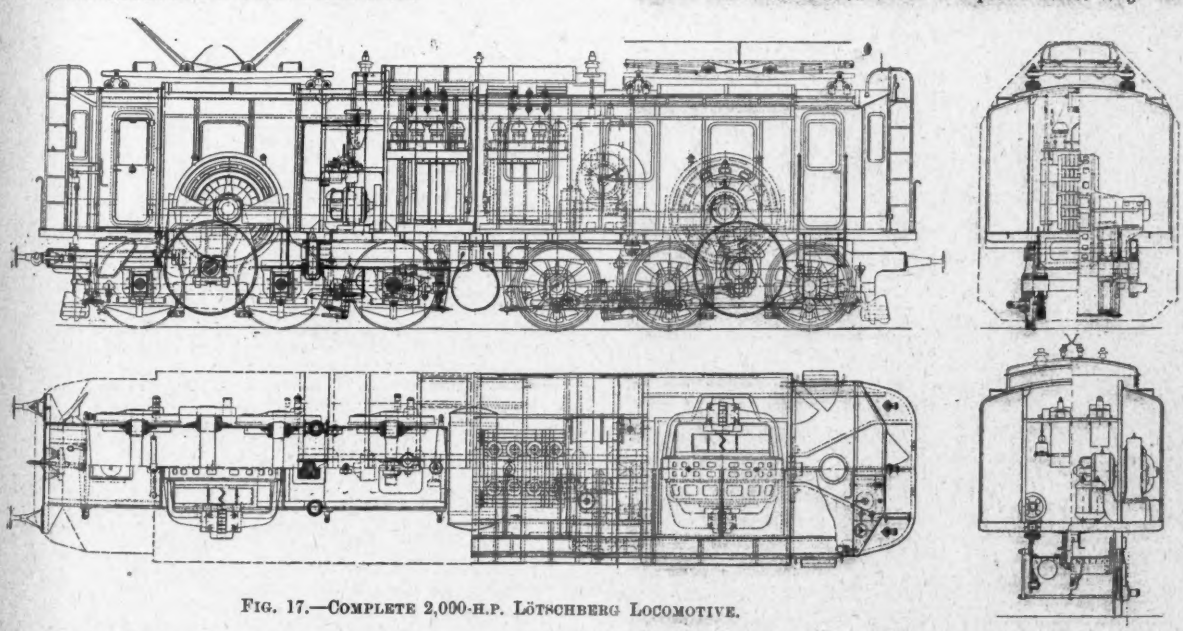


Fig. 17.—Complete 2,000-H.P. Lötschberg Locomotive.

St. Gotthard Railway.—The traffic on the St. Gotthard line has developed to the limits of steam operation. There is a continuous demand for more powerful engines for dealing, on the long and heavy grades, with a tonnage comparable with that of the busiest flat country main railways. The railway, with a length of 274 km. (170½ miles), presents the problem of electrification in a still more general way than does the Lötschberg, firstly, because the creation of the power stations forms part of the problem; and secondly, the more or less level sections north and south of the steep slopes require high speeds. Moreover, the St. Gotthard electrification is of unusual magnitude.

The Studiencommission has prepared two complete projects for this line. The first project, called "1904," has been prepared for the sole purpose of a fair and complete comparison of actual steam-traction with a hypothetical electric-traction under known precise conditions of traffic. The second project, called "Future," presupposes a traffic considerably in excess of the traffic of 1907, which Federal Railways, a few years ago, acquired ample water-powers in five places along the line, which amount to considerably more than what will be required by any electric traction scheme on the St. Gotthard.

In the hypothetical case of "1904," where electricity does not show to advantage on account of the small traffic to keep the plant busy, the cost per ton-kilometre of train weight, exclusive of locomotive weight, is exactly equal for steam and electric traction, if scrapping of useless steam locomotives is not considered: if it is, the cost of electric traction is not quite 3·5 per cent. in excess. On account of the greater weight of steam locomotives, steam traction appears to be notably cheaper, if measured by ton-kilometres inclusive of locomotives.

Under the "future" conditions of traffic, electric traction is much cheaper than steam traction was in 1907 and 1908, depreciation of steam locomotives, now still running but useless elsewhere, being fully considered. The difference is so great that the conclusion

appears to be justified that the St. Gotthard can be operated electrically at a financial advantage over steam in the near future.

Interest on new capital investment and depreciation of new plant have been fully considered in determining the cost of operation.

Though cheaper operation as expressed in figures is the only efficient stimulus in the case of a railway, still, the greater comfort to travellers, to train crews and to trackmen in the tunnels—of which there are more than 46 km. in all—the reduced corrosion of rails in tunnels, the less rapid deterioration of the carriage outfits,

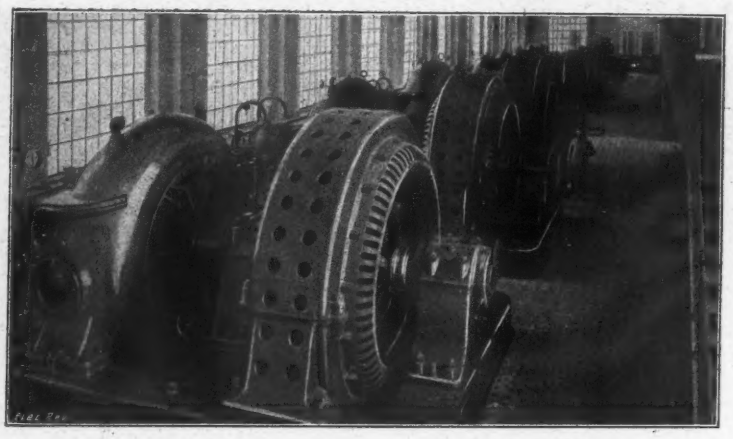


Fig. 18.—Interior of Power Station supplying the Lötschberg Railway.

the elimination of the feed-water nuisance in winter, the cost of coal probably increasing, and many other things not expressed in figures, are of considerable practical importance, and will, if the estimates appear satisfactory, cause electrification to come earlier.

Conclusion.—Railway electrification has made, and is making, good progress in Switzerland. As regards system, single-phase current of low periodicity (15) and high contact line voltage, varying from 5,000 to 15,000, according to circumstances, is being sanctioned by experience and by authority.

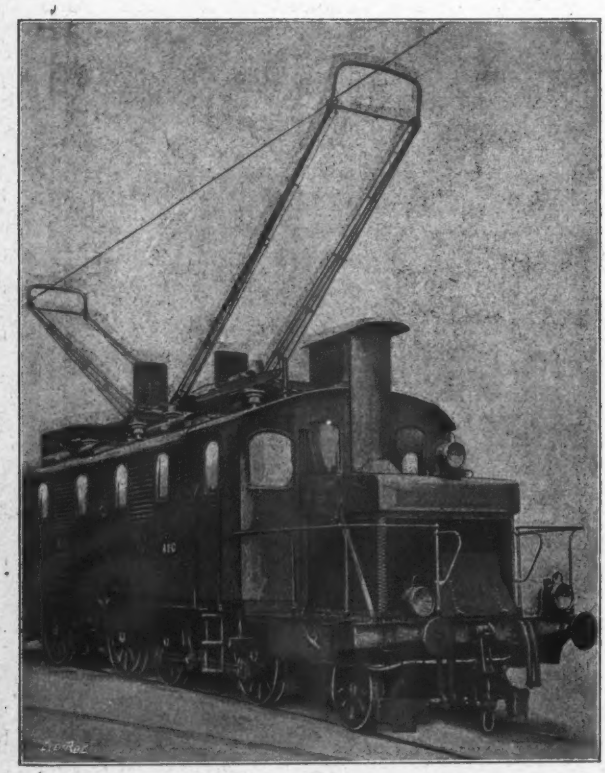


Fig. 19.—A.E.G. 1,600-h.p. Lötschberg Locomotive.

An important electrification of a new principal line—the Lötschberg—is to be carried out in the immediate future, and a still more important one, that of the St. Gotthard Railway, is well prepared.

Railway electrification and electric traction on a large scale is in a great measure a problem of power station economics. All electrification in Switzerland is directly connected with the utilisation of water power.

FERRARIS METERS ON VARIABLE LOAD.

In a recent communication from the Physikal. Techn. Reichsanstalt, K. Schmiedel describes a valuable investigation into the accuracy of Ferraris meters on variable current and voltage supply. Motor and clock meters are practically unaffected by such variations (Orlich and Schulze, 1909), but in Ferraris meters there is the damping effect of the stray A.C. flux from the current and pressure coils to be considered, in addition to frictional damping.

From the differential equation of rotation of the meter armature it follows, by a very simple process of approximation, that if a Ferraris meter at standstill be suddenly loaded with its full-load current—which is maintained constant till full speed is attained (after time t_1), and then suddenly and completely removed, only to be again restored after time t_2, during which the meter just comes to standstill, and so on (fig. 1)—an error F is introduced in the reading of the instrument given by—

$$F = f \cdot \frac{1}{t_1} \cdot \frac{K \cdot B}{A^2}, \quad \ldots \quad (1)$$

where K = armature mt. of inertia (cm.^{2}grm.).
f = frequency of supply.
A = damping torque due to permanent magnet and voltage coil stray flux,
B = full load damping torque due to stray current coil flux,
} at ω = 1 radn./sec.

The meter reads too high, and by an amount clearly proportional to the armature moment of inertia and the current coil stray flux.

By arranging a circuit as in fig. 2, a number of Ferraris meters (a—d) may be subjected to such a variable load as the above by aid of the rotating switch S. The meter readings are compared with that of a standard Aron meter N, and during the time the meters are out of circuit a substitutional resistance r is inserted to maintain a constant load on the supply G.

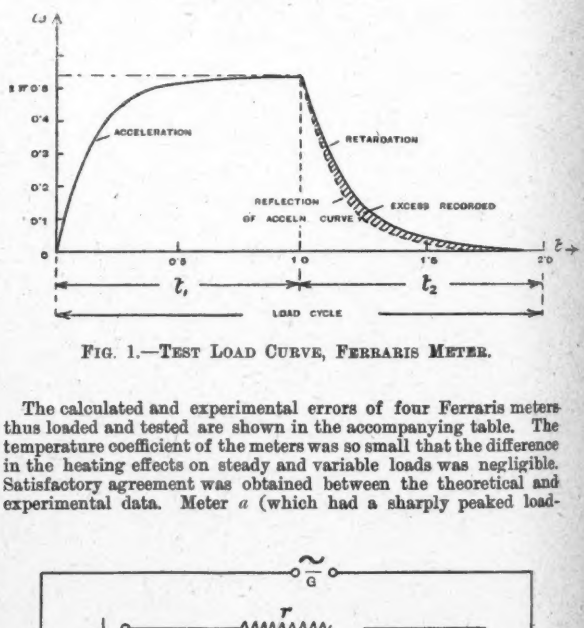


Fig. 1.—Test Load Curve, Ferraris Meter.

The calculated and experimental errors of four Ferraris meters thus loaded and tested are shown in the accompanying table. The temperature coefficient of the meters was so small that the difference in the heating effects on steady and variable loads was negligible. Satisfactory agreement was obtained between the theoretical and experimental data. Meter a (which had a sharply peaked load-

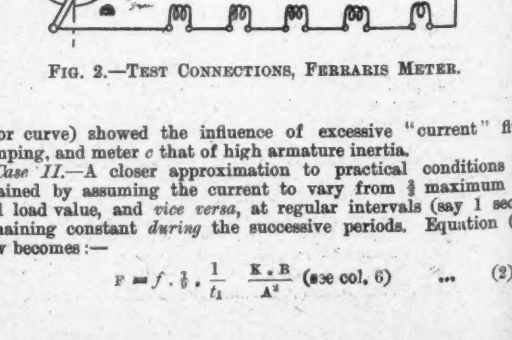


Fig. 2.—Test Connections, Ferraris Meter.

error curve) showed the influence of excessive "current" flux damping, and meter c that of high armature inertia.

Case II.—A closer approximation to practical conditions is attained by assuming the current to vary from $\frac{1}{2}$ maximum to full load value, and *vice versa*, at regular intervals (say 1 sec.), remaining constant *during* the successive periods. Equation (1) now becomes:—

$$F = f \cdot \tfrac{1}{6} \cdot \frac{1}{t_1} \cdot \frac{K \cdot B}{A^2} \text{ (see col. 6)} \quad \ldots \quad (2)$$

and the errors due to the variable loading do not equal the difference in error frequently existing between half and full (steady) load.

Meter.	Max. driving torque (cm. gm.).	Mt. inertia armature. (cm. gm.).	Calculated error. Case I.	Experimentally determined error. Case I.	Calculated error. Case II.
a	7·61	322	+ 1·7%	+ 1·9—2·6%	+ 0.2 %
b	4·77	236	+ 0·4%	+ 0·2—0·5%	+ 0·04%
c	2·99	362	+ 1·5%	+ 1·1—1·7%	+ 0·2 %
d	7·19	339	+ 0·4%	+ 0·4—1·1%	+ 0·04%

If the meter be subjected to such rapid current variations ($t_1 < \frac{1}{2}$ sec.) that the armature cannot complete its acceleration or retardation ere a fresh load variation occurs, the error equation becomes very complex, and quite considerable errors arise.

In most cases the damping due to the stray voltage circuit flux is considerably greater than that due to the "current" flux, hence the former exercises the more serious effect on the accuracy of the meter. Nevertheless, as the result of theoretical and experimental investigations, it is found that only on very rapid (and considerable) variations of voltage does the influence of the latter on the accuracy of the meter become serious.

Thus, in order that Ferraris meters may be as independent as other types of current and voltage variations, it is only necessary to avoid (1) high armature inertia; (2) powerful damping torque (as compared with the driving torque), due to stray "current" or "pressure" flux; (3) large variations of current or voltage of short duration.

ELECTRICITY FROM A DRAINAGE CANAL.

(*Concluded from page* 319.)

Transmission Line, Terminal Station, Sub-station and Distribution Systems of the Sanitary District of Chicago.

The main transmission line of this installation follows the East Bank of the drainage canal from the generating station 1½ miles below Lockpool, to the Western Avenue terminal station 30 miles away, where the transmission pressure of 44,000 volts is stepped down to the city distribution pressure of 12,000 volts.

As first constructed the transmission line comprised two circuits of 19-strand aluminium conductor, equivalent in current-carrying capacity to No. 000 copper. These circuits were carried upon 50,000-volt petticoat insulators mounted on steel poles or towers. The poles are of bridge construction, measure 60 ft. overall, and are set 6 ft. in concrete, which is rounded off above the surface of the surounding ground to provide drainage for any water that may collect at the base. The lower cross-arm, also of steel lattice work construction, measures 18 ft. across, and the upper cross-arm 12 ft. When first erected the two circuits were installed in the usual manner on these cross-arms, and an earth wire clamped at the peak of each pole was carried throughout the length of the line.

In order to secure additional carrying capacity for the increasing load, the original arrangement of the transmission wires has been modified by the addition of two suspension type insulators hung from the lower crossarm at points midway between the original petticoat insulator pins. Mounting an additional petticoat insulator at the peak of the poles will thus make available nine insulated wires, *i.e.*, three separate circuits. The last wire, taking the place of the original earth wire, is, according to the New York *Electrical World*, now being erected. During the past summer, however, the line has been worked with the pole peak earth wire in position and earthed at every fourth tower. This arrangement was undertaken in order to avoid lightning disturbances, and particularly satisfactory results have been obtained from the protected circuit. The circuit on the south side of the pole line formed by the lines carried on the two petticoat insulators and one suspension insulator on the lower arm has been equipped with the earthed-ring type of protection.

At each of the numerous railway crossings the petticoat insulators are replaced by strain insulators in each direction, employing also suspension type and pin insulators at each such junction.

The steel towers are erected at 350-ft. intervals, and for 18 miles of the line are set in holes blasted out of the solid rock and afterwards filled with concrete. The vertical shafts of these towers are 42 in. square at the base and 14 in. at the top, and each tower complete weighs 1·8 tons.

Following the transmission line an underground telephone cable has been laid between the terminal station and the power house, providing two separate circuits. At half-mile intervals these cables are brought up to junction boxes at the surface of the ground, where the line patrol men can obtain communication with the generating station by inserting the plug of the lineman's telephone set. This telephone line is, of course, quite free from noise or inductive effect.

The Western Avenue terminal station of the transmission line, where the incoming 44,000-volt energy is transformed to a pressure of 12,000 volts for distribution within the city limits, is situated on the south bank of the drainage canal near the Western Avenue Bridge. The building is a concrete block structure measuring 124 ft. × 70 ft. × 24 ft. high. Besides housing the transformers, this building contains the distributing equipment for the 12,000-volt circuits, and a 2,300-volt sub-station for supplying energy to lamps and motors in the immediate neighbourhood.

The transmission lines are led into the station through hooded entrances at the second floor or gallery level. At this point provision is made, by an arrangement of cross-connecting switches, for quickly utilising as a transmission delta any three of the six complete conductors which may remain unaffected in case of partial breakdown of the line. The line is protected at the end by 44,000-volt aluminium cell lightning arresters. After traversing the choking coils, the energy is led through transformer switches, and through series transformers operating the trip relays on these switches. Six banks of 4,000-kw. each oil-insulated water-cooled transformers have already been installed in the station for handling the transmission circuits. The high-tension bus-bars are equipped with motor-operated oil switches for tying together the high-tension sides of adjacent pairs of transformers. This arrangement is also duplicated in both the main and transfer bus-bars in the low-tension side of the transformers. All the 44,000-volt conductors in the station, which are carried on the insulators mounted on pipe construction, are painted red, as a danger signal to workmen.

The 12,000-volt leads from the transformer banks are taken to the hinge terminals of double-knife, double-throw disconnecting switches. The upper terminals of these switches communicate with the main station bus-bars through motor-controlled oil switches, and from these main bus-bars through solenoid-operated oil switches, and thence through double-knife, double-throw, disconnecting switches, similar to those described above, with the respective outgoing commercial circuits. The lower clips of the transformer switches are connected through electrically operated oil switches to the transfer bus-bars, and thence through another group of hand-operated switches to the lower clips of the feeder line double knife switches. This seemingly complex arrangement of knife switches makes it possible to transfer a circuit from the main to the transfer bus-bar, or *vice versa*, without interrupting the supply to the feeder. The sectionalising switches in the 12,000-volt bus-bars are, like those in the 44,000-volt bus-bars, equipped with time-limit relays. There are 20 outgoing circuits, each feeding separate parts of the city.

The control of the transformer switches on both the 44,000-volt and 12,000-volt sides is effected from a bench-board on the operating gallery at the south side of the station.

At the north end of the station is an 18,000-kw. bank of oil-insulated water-cooled transformers, stepping down from 12,000 volts to 2,300 volts to provide the supply for adjacent consumers. At this building also are two centrifugal pumps for supplying cooling water for the various transformers, and two motor-generator sets for furnishing direct current for station lighting and oil switch operations. These pumps and direct-current generators are direct-coupled to 440-volt, three-phase induction motors.

In a small separate building is situated a 60-cell battery which supplies energy for actuating the remote-control switches in the station.

As the sanitary district of Chicago is a public body organised and supported by the ratepayers who compose the population of the City of Chicago and an outlying fringe of territory, the trustees of its board have naturally taken the view that its electrical output should, as far as possible, be utilised for the public benefit of the population, and large use has accordingly been made of the energy for municipal lighting and pumping purposes.

Of course, when the system was first put into operation municipal needs were not equal to the output of the plant, and the sanitary district officials have organised a sales department for aggressively undertaking the distribution of its output to commercial concerns. The commercial load has in three years grown to a totally connected value of 20,000 h.p. in lamps and motors. The municipal load is meanwhile 13,357 h.p.

The rates for industrial motor service are based on a maximum demand system, the consumer's demand either being measured by a demand meter or estimated by multiplying his total connected horse-power by agreed percentage factors.

The rate for 12-hour lighting service is £3 2s. 6d. per h.p.-year to municipalities.

The affairs of the sanitary district are controlled by a board of nine trustees elected by the people, three being chosen each year.

Exhibition at West Hartlepool.—We have received a prospectus of the North of England Exhibition, which is to be held from November 13th to December 9th, 1911, at the Queen's Rink, Clarence Road, West Hartlepool. The 34 sections include foods, drinks, sports, motor-cars, church furniture, dress and fashion, perfumery and so forth, but what may be of more direct interest to our readers from the business point of view are the following:—Mining and metallurgy; shipbuilding (including electric lighting of ships); engineering and machinery; gas and lighting (which includes machines for generating electricity); electricity; smoke abatement, &c. There is a total floor space available for exhibits of nearly 38,000 sq. ft. Copies of the prospectus may be obtained from the general manager, Mr. G. Scott, 7, Victoria Road, West Hartlepool.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

FRANCE.—The French Customs Authorities have recently issued the following decisions as to the duties to be levied on certain imported goods:—

	Francs per 100 kg.
Steam boilers with internal furnaces furnished with Galloway and similar tubes, the number of tubes per furnace being:	
At most 5	10·50
More than 5	14
Automatic regulators for turbines	10
Ventilators worked by electricity:	
Small apparatus consisting of a motor furnished with metal wings: motor dutiable as "dynamo-electric machines" at rates from ...	13 to 110 (according to weight)
Wings dutiable as "detached parts of machines, other than electric," or "manufactures of aluminium, other," or "nickelled manufactures," according to kind.	
Apparatus of large size without electrical equipment, to be worked (by means of a transmission band) by an electric motor, dutiable as "ventilators according to kind," at rates varying from	8 to 15
Apparatus of large size, other, provided with coils and electrical attachments, dutiable as electrical apparatus, according to kind, at rates varying from	30 to 110
Electric cranes—motor, rheostat and electric engines, crane properly so-called—and wagon or truck (if any), are subject to duty separately.	

NOTE.—Where the exact duty is not stated above, reference should be made to the tariff published in the ELECTRICAL REVIEW, in which the rates of duty by headings mentioned are given.

ARGENTINA.—The Argentine *Boletin Oficial (Official Gazette)* for July 18th contains a revised list of the materials and articles which may be imported into the Republic free of duty by such railway and electric tramway companies as are entitled by law to this privilege, for the construction and working of their lines. The Board of Trade have received a copy of this *Boletin*, and it may be inspected at the Commercial Intelligence Branch, 73, Basinghall Street, E.C.

NEW PATENTS APPLIED FOR, 1911.

(NOT YET PUBLISHED.)

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford, to whom all inquiries should be addressed.

18,322. "Electric controlling or synchronising pendulums." R. MILNE. August 14th.

18,394. "Electrical heating and ventilating appliances." F. RIPPINGILLE August 14th.

18,391. "Electrical heating element." T. JUDD. August 14th.

18,351. "Manufacture of metal filaments for electric lamps." E. R. GROTE. August 14th.

18,355. "Method and apparatus for the reception and production of sound waves." O. REINHARDT. (Convention date, March 1st, 1911, Germany.) August 14th. (Complete.)

18,360. "Reversible galvanic batteries." W. MORRISON. (Convention date, October 10th, 1910, U.S.A.) August 14th. (Complete.)

18,375. "Terminal clips for electric wires." J. H. KAESEN. August 14th. (Complete.)

18,392. "Manufacture of filaments for incandescent electric lamps." H. HOGE and "Z" ELECTRIC LAMP MANUFACTURING Co., LTD. August 14th.

18,462. "Mountings for wall telephone sets." SIEMENS BROS. & Co., LTD. (Siemens & Halske Akt.-Ges., Germany.) August 15th. (Complete.)

18,473. "Heating liquids by electricity." T. MCCLELLAND, JUN. August 16th.

18,487. "Electrically-propelled vehicles." E. M. MUNRO and R.E.T. CONSTRUCTION Co., LTD. August 16th.

18,526. "Dynamos." A. A. PRICE. August 16th.

18,575. "Starting switches for electric motors." SIEMENS BROS. DYNAMO WORKS, LTD., and E. SCHUPP. August 17th. (Complete.)

18,583. "Electric light fittings." M. J. RAILING and G. MAURICE. August 17th.

18,584. "Fixing the covers of electrical switches and the like fittings." M. J. RAILING and G. H. IDE. August 17th.

18,586. "Telephones." B. GWOZDZ. (Addition to 17,863 of 1911). August 17th. (Complete.)

18,611. "Automatic starters for electric motors." M. B. FIELD and FERRANTI, LTD. August 17th.

18,630. "Magnetic compasses." KELVIN and J. WHITE, LTD., F. W. CLARK and HON. L. W. P. CHETWYND. August 18th.

18,648. "Automatic telephone exchange systems." WESTERN ELECTRIC Co., LTD. (Western Electric Co., United States.) August 18th. (Complete.)

18,649. "Telephone exchange circuits." WESTERN ELECTRIC Co., LTD. (Western Electric Co., United States.) August 18th. (Complete.)

18,667. "Electric switches." H. A. CRABB, A. H. F. PERL and C. H. HUTCHINSON. August 18th.

18,674. "Machines for covering or insulating wire." D. NOBLE. (Convention date, August 18th, 1910, United States.) August 18th. (Complete.)

18,680. "Attachment of insulator carrying arms to telegraph and like poles." BULLERS, LTD., and E. H. CHAMBERS. August 19th.

18,692. "Electrical indicating systems." E. J. WEEKES. August 19th.

18,693. "Electrical signal apparatus." W. S. REYNOLDS. (Convention date, March 17th, 1911, United States.) August 19th. (Complete.)

18,783. "Carbon electrode for electrical purposes." PLANIAWERKE AKT.-GES. FUR KOHLENFABRIKATION. (Convention date, October 6th, 1910, Germany.) August 19th. (Complete.)

PUBLISHED SPECIFICATIONS.

Copies of any of the Specifications in the following list may be obtained of MESSRS. W. P. THOMPSON & Co., 285, High Holborn, W.C., and at Liverpool and Bradford; price, post free, 9d. (in stamps).

1910.

SWITCHING MEANS FOR DYNAMOS FOR CHARGING ACCUMULATORS FOR USE WITH MOTOR-CARS AND OTHER VEHICLES. J. E. Olvis. 9,775. April 21st.

ELECTROMAGNETIC SEPARATOR DRUM OR PULLEY. James Hawley, Ltd., S. H. Saunders and —Jones. 17,126. July 19th.

PRINTING TELEGRAPH INSTRUMENTS. E. J. Kessels. 17,322. July 21st.

CONTROLLERS FOR USE IN CONNECTION WITH ELECTROMOTORS. Electric and Ordnance Accessories Co., J. R. Garner and M. H. Mueller. 17,349. July 21st.

ELECTRIC FURNACE WITH A RECEPTACLE FOR THE CHARGE ARRANGED ON THE FURNACE CHAMBER. A. Helfenstein. 17,650. July 25th. (July 27th, 1909.)

ELECTRIC CONTACT MECHANISM FOR THE AUTOMATIC STOPPING OF MACHINES. V. Hallstream. 18,012. July 28th.

ELECTRIC MOTOR CONTROLLERS. Adams Mfg. Co. (Cutler-Hammer Mfg. Co.) 18,191. July 30th.

DYNAMO-ELECTRIC MACHINERY. Brown, Boveri & Co. (Akt.-Ges. Brown, Boveri et Cie.) 18,195. July 30th.

LAMPS OR LANTERNS FOR INCANDESCENT ELECTRIC LAMPS. W. Wardle. 18,341. August 2nd.

ELECTRICAL CUT-OUTS. A. C. Reyrolle and A. Reyrolle & Co. 19,851. August 25th.

AUTOMATIC ELECTRIC SWITCHES. H. Leitner. 20,257. August 30th.

MEANS OF CONTROLLING THE CONNECTION AND DISCONNECTION OF A PLURALITY OF ELECTRICAL CIRCUITS TO OR FROM ANOTHER SUCH CIRCUIT. J. Sutton and C. J. Sutton. 20,685. September 15th.

PUSH-BUTTON ELECTRIC SWITCHES FOR CONTROLLING ELECTRIC LIFTS AND THE LIKE. J. C. Etchells. 22,356. September 27th.

AUTOMATIC TELEPHONE SYSTEMS. E. Neuhold. 23,669. October 12th. (October 27th, 1909.)

1911.

VEHICLES FOR GRAVITY OR SWITCHBACK RAILWAYS OR TRAMWAYS. J. R. Trigwell and G. Lynch. 1,215. January 17th.

DRIVING MECHANISM FOR ELECTRICALLY-PROPELLED VEHICLES. Tribelhorn. 3,151. February 8th.

ELECTRIC INSULATORS. Bullers, Ltd., and G. V. Twiss. 3,272. February 8th.

ELECTROLYTIC METERS. E. Weintraub. 3,648. February 13th. (February 14th, 1910.)

TIME-LIMIT OR RETARDING DEVICES FOR USE WITH ELECTRIC CIRCUIT-BREAKERS. Electric and Ordnance Accessories Co. and N. Collins. 4,457. February 22nd.

PROCESS FOR THE CLOSING OF THE SEAMS OF TUBES BY MEANS OF ELECTRIC RESISTANCE WELDING. D. Timar and L. Presser. 4,602. February 23rd. (May 2nd, 1910.)

ELECTRICAL SWITCH OR CONTROLLING DEVICE. G. Wallace and J. E. Graham. 6,861. March 18th.

ELECTRICAL TIME-SWITCH. G. Wallace and J. E. Graham. 6,862. March 18th.

CONTINUOUS ELECTRIC CURRENT GENERATORS WITH SEPARATE EXCITATION. Fried. Krupp Akt.-Ges. 7,045. March 21st. (May 18th, 1910.)

CARTRIDGE FUSES FOR ELECTRICAL PURPOSES. W. Creswick and J. Bentham. 9,038. April 11th.

The Continental Electrical Industry.—The Bank for Electrical Enterprises, of Zurich, in the course of its annual report for the year ended with June, 1911, refers to the general economic situation in Switzerland, Germany, and other countries in Europe, which is stated to have undergone no thorough change. Although the electrical manufacturing industry is well employed, and, in part, even very well employed, complaints are made almost everywhere of inadequate prices. Among the undertakings which show a progressive development even in times of quietness in business the report mentions electricity supply works; the result is regularity in the proceeds, and as a consequence further circles of investors turn to the shares of such companies for investment. Nevertheless, competition manifests itself still where exclusive rights are not held, and this often renders it difficult for individual works to develop in a profitable manner. As far as railway working by electricity is concerned, the report states that the system is becoming a fact to an increasing extent now that the trials made by authorities have proved its great superiority in working in all cases where the traffic is heavy, and the method is the most economical where water-power or cheap fuel is employed. Whilst Germany, England, France and Italy were effecting the conversion of railways to electric traction at a rapid rate, Switzerland for the time being was still maintaining a waiting attitude. Naturally, the large manufacturing firms were destined to derive advantage in the first place from the general employment of electrical energy for industrial and traction purposes. But notwithstanding the favourable prospects for such firms, the report remarks that with one exception the bank has not considered it advisable to increase its holding of shares in manufacturing companies, as experience has shown that the dividend results of such securities can be largely influenced by the conditions of trade prevailing at any time.